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See Vol. 23 for
additional data.

SECOND SERIES: PULMONATA.

MANUAL

OF

CONCHOLOGY

STRUCTURAL AND SYSTEMATIC

WITH ILLUSTRATIONS OF THE SPECIES

VOL. XXI

ACHATINELLIDÆ

(AMASTRINÆ)

BY

ALPHEUS HYATT

AND

HENRY A. PILSBRY

LEPTACHATINA BY C. MONTAGUE COOKE

PHILADELPHIA:

Published by the Conchological Department

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

1911

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11

It is the nature of a God to conceal a thing; it is the glory of a man to find it out.—FRANCIS BACON.

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TO THE MEMORY OF

GEORGE ALBERT ARMS

OF GREENFIELD, MASS.

A LOVER OF TRUTH AND PROGRESS

THROUGH SCIENTIFIC RESEARCH

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PREFACE.

As the title-page indicates, this monograph contains the results of work by two authors. The Achatinellidæ had been studied by Professor Alpheus Hyatt for many years prior to his death in 1902. "It is unfortunate that he never fully wrote out the results of his studies upon these shells, the manuscript which was found after his death being very incomplete, especially upon specific points; and although many of his descriptions of the species themselves were completed, yet his conclusions respecting their relationships and migrations are only vaguely referred to."[1]

Professor Hyatt's notes, relating to about 130 of the 280 species treated in this volume, were submitted to the junior author in the spring of 1906, with the condition that they be incorporated in the present monograph so far as practicable. The manuscript received contains all of his notes descriptive of genera and species, their localities, classification and relationships, also sketches of his views upon the migrations of the Amastræ of Oahu and of the Laminellæ, which are printed in full in Appendix B (p. 358). Aside from this, the manuscripts include none of Hyatt's deductions and theoretic conclusions bearing on the origin, evolution or zoogeography of Achatinellidæ; this material having been reserved for separate publication. The junior author is therefore alone responsible for zoogeographic views expressed herein, except in so far as these views coincide with those of Hyatt's essay forming Appendix B. It should be said that Hyatt's theoretic views on the migrations of *Achatinellidæ*, as expressed in Appendix B (pp. 358 to 368) are directly opposed to those of the junior author. Those inter-

[1] Alfred Goldsborough Mayer in Popular Science Monthly, February, 1911.

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ested will find the evidence upon which both views are based in the descriptive part of this volume.

In matters of taxonomy the two authors are in almost complete agreement. Diverse methods and different material for investigation have caused some difference of view regarding the rank and relationships of the subdivisions and species of *Amastra*, and the relationships of the Laminellæ. Here both views are given, pp. 358–368 (Hyatt) and 137, 324 (Pilsbry). The chief advance over former classifications of Pease, Gulick and others is in the recognition of Heliciform genera derived from *Amastra*, containing forms which were formerly placed in the Helicoid families Endodontidæ or Helicidæ. The true relationship of *Pterodiscus* was published by Pilsbry in 1905, without knowing that Hyatt had reached the same result several years earlier, but had published nothing on the subject. The Heliciform genera *Planamastra* and *Armsia* were unknown to Hyatt.

Only a few incomplete notes relating to the genus *Leptachatina* were left by Hyatt. The account of this intricate group has been prepared by Doctor C. Montague Cooke, of Honolulu, who has studied all of the principal collections of these snails in Europe, America and the Islands.

The original descriptions of species, or translations of them, have been quoted in nearly all cases, though sometimes dispensed with when the original types were before us. This use of an author's own words permits the limitation of additional descriptive matter to the exposition of points originally unnoticed, or inadequately set forth; yet often of the first importance in phylogenetics. Such additional matter is given either from the notes of Hyatt, confirmed by the junior author, or from observations by the latter. Views specially Hyatt's are quoted or otherwise distinguished.

Acknowledgment is due to Mrs. J. M. Arms Sheldon whose liberality has enabled us to illustrate this volume and the one to follow more fully than would otherwise have been possible.

Our generous friend Doctor C. Montague Cooke has left his large Hawaiian collection in our possession for ten years, and has freely given specimens and information of the first import-

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ance to our inquiries. Mr. D. D. Baldwin, the Nestor of Hawaiian conchologists, has lent or given many types and cotypes from his collection. Dr. William H. Dall permitted both authors freely to make use of the collections of the National Museum under his charge. Mr. C. W. Johnson extended to the junior author a like courtesy with the collections of the Boston Society of Natural History, which had been the basis of Professor Hyatt's studies. Mr. D. Thaanum of Hilo, Hawaii, has contributed large series of Hawaiian shells of his own collecting during many years. Prof. George Wagner submitted a large series of the shells of Molokai from the zoological museum of the University of Wisconsin. This collection was made by Dr. W. J. Goodhue, an American physician at the leper colony, and received through Father Dutton. Other shells for study have been received from Mr. E. P. Van Duzee of Buffalo, N. Y. (taken by his father, 1837–40), and from Mr. Arthur H. Norton, Curator of the Portland Society of Natural History. For specimens and information pertaining to particular species we are indebted to others, as acknowledged in the text. Finally, I would express my appreciation of the careful work of Miss Helen Winchester, who drew on stone the 884 figures illustrating this volume. H. A. P.

October, 1911.

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INTRODUCTION.

Evolution and Zoogeography of the Amastrinæ.

I. Achatinellidæ the new incarnation of an ancient phylum.
II. Geologic and topographic data bearing on the evolution of Achatinellidæ.
III. Means of dispersal.
IV. Centers of radiation.
V. Systematic and geographic relationships of genera and subgenera.
VI. Probable sequence of events determining evolution of the Hawaiian fauna.

I.

The *Achatinellidæ* are a branch of the primitive and ancient group *Orthurethra,* a group comprising most of the land Pulmonata of the Pacific islands, including also the families *Partulidæ*, *Tornatellinidæ* and *Pupillidæ*. Such evidence as we have leads us to infer the existence of Orthurethrous snails in the Pacific for a very long time, probably since the Palæozoic. The total absence of modern types of land Pulmonata in these archipelagos, as I have elsewhere argued, is against the view that their snail faunas are solely due to waifs from the continents, adventitiously stranded from time to time.

By analogy with generic and family groups of known age in Europe and America, it seems likely that the *Achatinellidæ* were already differentiated as a family before the beginning of the Tertiary. Yet the rather close relationship of the genera of *Amastrinæ*, and the even greater proximity of the genera of *Achatinellinæ*, seem to tell of a rather sudden expansion

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or rejuvenescence of the old stock in comparatively modern (Tertiary) time. The aspect of youthful exuberance in the Achatinellid fauna is remarkable. Phylogerontic or aged groups, such as are usually common in old island faunas, are conspicuously wanting. Everywhere intense local differentiation is in progress.

II.

The Hawaiian Islands are, as is well known, volcanic masses standing upon the southeastern end of a submarine ridge, over 1,700 miles in length, stretching from Ocean and Midway Islands to Hawaii, and rising from a depth of about 3,000 fathoms. The present islands being wholly volcanic, so far as known, many geologists have assumed that the entire ridge has been built up of volcanic materials. This inference is unsupported by evidence. The Andean ridge is not wholly volcanic because it is crowned by great volcanoes. It is quite possible that the Midway-Hawaiian ridge is a product of diastrophism which preceded the volcanic period. However this may be, the richness and peculiarity of the fauna and flora, and the belief that the volcanic islands as they now stand are probably of no great age, has led to the hypothesis that formerly a much greater land area existed, now lost by subsidence. So conservative a zoogeographer as Wallace considers this probable; and except for an advocate of special creation, the theory of a land area antecedent to the present volcanic islands seems necessary to account for the faunal characteristics. That there has been a progressive deepening or sinking of the floor in the great oceanic basins is a view now generally held, which, if well founded, accounts for the subsidence of the Hawaiian ridge.

The absence of drowned valleys and fjords, as well as the great sea-cliffs where the waves have gnawed deep into the peripheral volcanic deposits, speak against recent subsidence. There is evidence of slight elevation in some places; but the islands seem to have remained practically stationary since the cessation of volcanic activity in the older masses. Geologists are chary of expressing an opinion on the age of the volcanic

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masses, in the total absence of palæontologic evidence. Those best acquainted with aqueous erosion as displayed in the Grand Canyon, etc., hold the opinion that the furrowing of the older Hawaiian volcanoes may readily have been accomplished in Neocene time, and possibly since the beginning of the Pliocene.

In this stationary period of the islands, during which the present complex topography has been developed from simple, unfurrowed slopes, the specific and varietal evolution of the *Achatinellidæ* seems largely to have taken place. The topographic features more or less closely coincide with or define the ranges of species and varieties. The development of topography and the evolution of species and varieties evidently proceeded pari passu. In former times, before the slopes became so rugged and the contrasts of ridge and valley conditions so emphatic, species doubtless spread much more freely than they do under present conditions. Thus in Hawaii *Amastra flavescens* has spread from the Hamakua district down to the southeastern slope of Mauna Loa. With subsequent isolation the more plastic of these widely-spread forms have evolved into chains of allied species or races. Precisely similar phenomena have been recorded by the author from the mountain chains of southern Arizona, where the bed of a canyon may separate distinct but related species.

Dana was the first to show that the Hawaiian volcanoes are progressively newer toward the southeast. Dutton qualifies this generalization: in the northwest they became inactive longer ago, and have therefore been sculptured by erosive activities for a longer time. In fact, Kauai, western Oahu, West Maui and northwestern Hawaii are long-extinct volcanic masses; eastern Oahu and East Maui newer, and the rest of Hawaii still in building. So far as is known, the Kohala region in Hawaii may be as old as Kauai.

Dana's generalization, which is thus subject to considerable qualification, was doubtless the basis of Professor Hyatt's hypothesis that the snails migrated from island to island, from Kauai southeastward. A considerable acquaintance with land shells causes me to doubt whether snails of moderate

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or large size have often been spread by the accidental means invoked to explain inter-island distribution, though we have the strongest evidence that small or minute land snails have spread, probably by hurricanes, over considerable distances. The actual facts of distribution of Hawaiian Island snails do not indicate, to my mind, a migration from Kauai.

III.

The logical geographic boundaries of most species of *Achatinellidæ* give excellent ground for the belief that the present distribution of all the larger species has been attained by their own means of locomotion, and that unusual or so-called accidental carriage, as by birds, drifting trees, etc., has been so rare as to be negligible. No evidence whatever of such carriage is known to me. It is likely that Unionid glochidia, Ancyli, or some other fresh-water mollusks may sometimes be transported by water-fowl, but I know of no North American land snail of moderate or large size, whose distribution requires such a hypothesis, excepting *Liguus* and *Hemitrochus* in Florida, which seem to have reached our shores without land communication. These snails inhabit trees on the keys of Florida—wooded islets but a few feet above the seas, sometimes actually swept by the waves, so that their transportation on drifting trees, as advocated by Mr. C. T. Simpson and others, seems possible, yet even in these cases the eggs may have been carried by hurricanes. In the Hawaiian Islands the *Achatinellidæ* inhabit mountain forests; there are no rivers to transport trees carrying snails to the sea. Even if so transported, the chance is almost infinitely remote that if cast up on another island the conditions on the shore would be favorable for such snails. If the transportation of arboreal Achatinellidæ by such means is improbable, that of large terrestrial forms is even more difficult. It is hardly worth while alluding to the possibility of these snails being transported by birds, since everybody having practical knowledge of land snails understands the absurdity of such a proposition.

As mentioned above, hurricanes have doubtless been instrumental in spreading minute species of land snails. If

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snails, why not their eggs? This I believe explains the wide distribution of closely related Leptachatinas. This genus alone, in the *Achatinellidæ*, is oviparous; and in it alone the minor groups are distributed widely, while in the other (viviparous) genera, the minor groups are special to the several islands. The young snails at birth are many times heavier than the eggs of snails of like size, and probably are not carried far by the wind, else they would become more widely spread locally.

If we have no logical ground for the belief that the viviparous *Achatinellidæ* have been spread over sea from island to island by such means as we have just considered, how has their spread been effected? Only by the traveling of the snails themselves over land and through forests now submerged. No other hypothesis is adequate to explain the facts of distribution, and the mutual affinities of the several island faunas.

IV.

Centers of Dispersal. — While none but palæontological evidence can be considered entirely conclusive in determining the area of origin and original dispersal of a group, yet in dealing with groups of sedentary, closely related, and strictly localized species, in a limited area, there cannot be much chance of error in holding that the region of greatest variety and abundance of such forms has been their center of evolution. Thus, in Oahu the eastern half of the main or Koolau range has fifteen species and many varieties of the group *Metamastra*, while the Waianae range has but three species, of which two are specifically identical with main range forms, the other closely related to them. The evidence is therefore very strong that the center of radiation of this group of species was in the eastern half of the main range, where also fossil species have been found, the few Waianae species being recent emigrants. By similar reasoning I conclude that the radiation-center of the group *Paramastra* was in the Waianae (Kaala or Western) range. By the same criteria, the typical group of *Amastra, Heteramastra* and

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Laminella arose in and radiated from the Molokai-Maui center, etcetera.

V.

Structural and Geographic Relationships of Amastrinæ.—Of the several subgenera of *Amastra*, we consider *Amastrella* nearest to the primitive progenitor of the group, because of the simplicity or lack of specialization in any part of the shell. All of the other groups have some special modification of shape, columellar lamella, embryonic whorls, or cuticle, which render it unlikely that any of them is so near to the original stock. The wide distribution of *Amastrella*, from Kauai to Hawaii—a range greater than that of any other Achatinellid group except *Leptachatina*—is also favorable to the theory that it is an old, unchanged group. *Cyclamastra* differs from *Amastrella* only by its open umbilicus, is also widely spread, from Kauai to Maui, and is apparently an early branch of *Amastrella*, the two being collateral phyla.

The Kauaian groups *Kauaia*, *Armiella* and *Carelia* stand much closer to *Amastrella* than to any other group, and have, in our opinion, been derived from Amastrellan ancestors. If so, all Kauian *Achatinellidæ* have been evolved from a primitive fauna composed of *Leptachatina*, *Amastrella* and *Cyclamastra*.

In the island of Hawaii, *Achatinellidæ* are almost entirely confined to the old northern portion of the island, where the family is represented by two groups of *Amastrellæ*, and a fossil species of *Heteramastra*. The few arboreal Achatinellas are related to Mauian forms.

The intermediate islands fall into two groups (*a*) Oahu, and (*b*) Molokai, Lanai and Maui. The fauna of these three islands is so homogeneous that there cannot be much doubt that they were formerly united into one large island. The chance that so many groups could attain a foothold on the three islands by adventitious means is so remote as to be negligible. It is on these two groups of intermediate islands that the *Achatinellidæ* reach their greatest development in numbers and diversity. *Leptachatina*, *Cyclamastra*, *Amas-*

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trella, Laminella and *Pterodiscus* are common to both the Oahu and the Molokái-Lanai-Maui centers.

(*a*) Oahu has two special groups, *Metamastra* and *Paramastra*, both believed to have evolved from *Amastrella*, and the genera *Armsia* and *Planamastra*, derived from Cyclamastran stock. The scarcity of *Laminella* species may be due to the competition of *Achatinella*, which is the dominant arboreal group.

(*b*) Besides the groups possessed in common with Oahu, the Molokai-Lanai-Maui area has all of the typical section of *Amastra*, all the Heteramastras except one Hawaiian species, and nearly all of the genus *Laminella*. Probably all of these groups were evolved from Amastrellan ancestors in this area. Several groups of *Achatinellinæ* are special to this tract.

VI.

From the affinities and the geographic relations of the several groups, as sketched above and discussed in detail in this work, we infer the following sequence of events, probably beginning in Mesozoic, possibly in Eocene, time:

I. The Hawaiian area, from northern Hawaii to and probably far beyond Kauai, formed one large island which was inhabited by the primitive Amastrinæ, ancestral forms of *Leptachatina, Amastrella* and *Cyclamastra*. This pan-Hawaiian land, whatever its structure, preceded the era of vulcanism which gave their present topography to the islands, and probably dates from the Palæozoic (Fig. 1).

II. Volcanic activity built up the older masses, subsidence following, Kauai being the first island dismembered from the Pan-Hawaiian area. The groups *Carelia, Armiella* and *Kauaia* were subsequently evolved thereon from the Amastrellan stock. Meantime the differentiation of Amastrine groups from the primitive Amastrellæ and Cyclamastræ began on the larger land-area remaining (Fig. 2).

III. Northern Hawaii was next isolated by formation of the Alenuihana Channel, leaving a large intermediate island, which included the present islands of Oahu, Molokai, Lanai and Maui.

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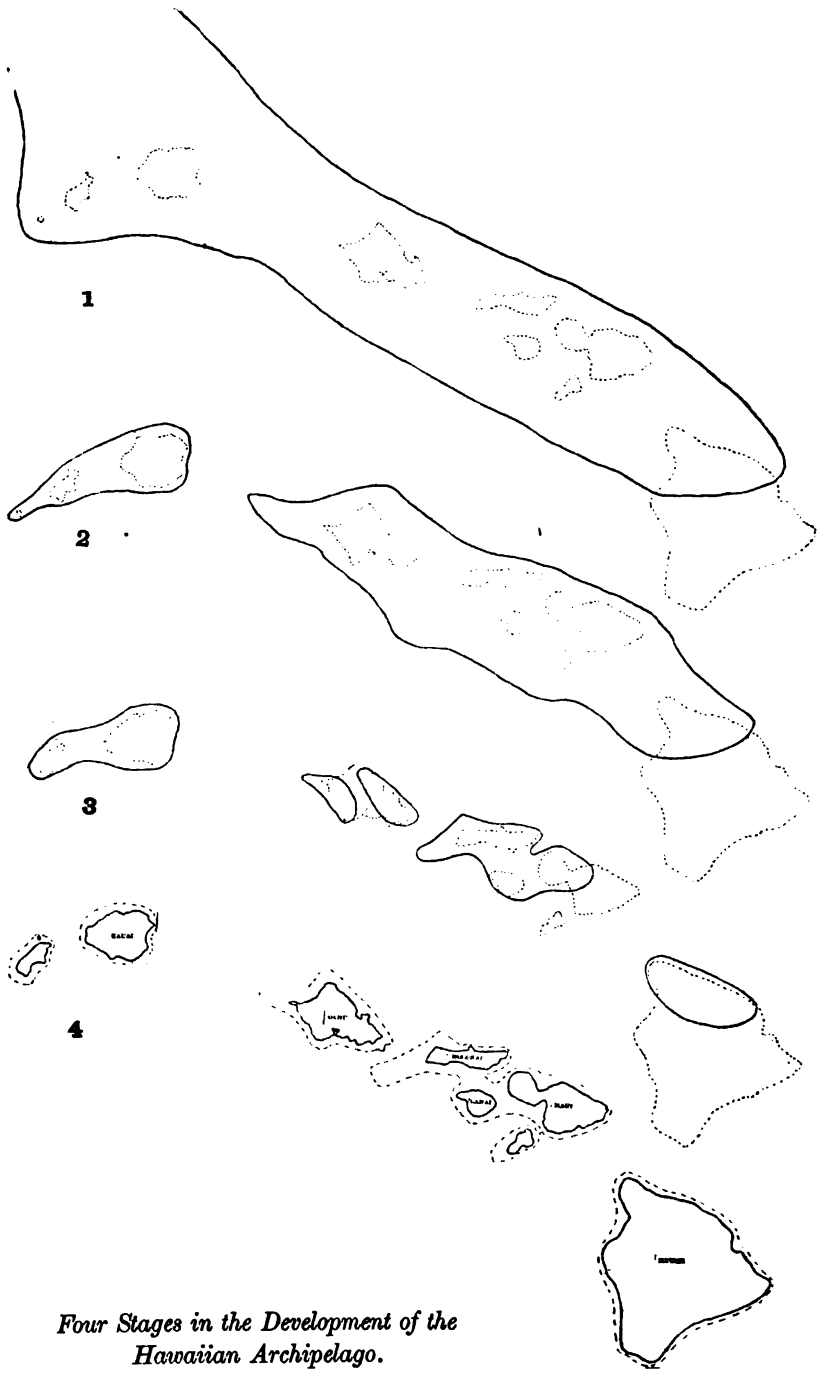

Four Stages in the Development of the Hawaiian Archipelago.

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IV. In the eastern end of this Oahu-Maui island *Laminella* arose from Amastroid, and in the west, *Pterodiscus* was evolved from *Cyclamastra* stock.

V. (Fig. 3.) The Oahuan and the Molokai-Lanai-Mauian areas were sundered by subsidence of the Kaiwi Channel.

(*a*) In Oahu there were two centers, probably two islands, a western or Waianae, and an eastern or Koolau area. In the Waianae center, *Paramastra, Planamastra* and *Armsia* were differentiated, while *Metamastra* arose from Amastrella in the Koolau area, where arboreal *Achatinellidæ* chiefly flourished. In late Pliocene or Pleistocene time a forested connection was established between the two Oahuan evolution-centers. This transitory connection allowed some intermingling of the two faunas; but while the land connection endured to the present time, the forests became extinct, again isolating the two centers so far as arboreal or forest snails are concerned.

(*b*) That the eastern or Molokai-Lanai-Maui region formed a single large island up to late Pliocene or even to Pleistocene time is evident from the very close relationship of the faunas of those islands. In view of the intense local differentiation everywhere observed in the Hawaiian group, we could hardly expect closer relations between the species of these three islands if they were still united. Various Achatinellinæ of *Partulina* type, the typical group of *Amastra* (found nowhere else), the subgenus *Heteramastra* and the genus *Laminella*, are the chief groups of this area. Probably all had been differentiated before the separation from Oahu, though part of them never spread, apparently, so far as that island. The formation of channels between Molokai, Lanai and Maui must be considered a very recent event. These islands stand on a common platform within the 100-fathom line (see fig. 4, representing the present islands, the 100-fathom contour in broken line).

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Family ACHATINELLIDÆ Tryon.

Achatinellidæ TRYON, Structural and Systematic Conchology, iii, 1884, p. 64, exclusive of *Auriculella* and *Tornatellina*.

Orthurethrous land snails having an oblong, ovate or rarely Helicoid shell, umbilicate or imperforate, generally with a spiral columellar lamella in the last whorl, the outer lip simple or thickened, not reflexed; no parietal lamella or tooth.

Kidney not much longer than the pericardium, passing into a long ureter reaching nearly to the collar. Venation of the lung extremely minute, the pulmonary vein having no large branches. Penis bears a long appendix; vas deferens free throughout. Spermatheca imbedded in the albumen gland, its duct long. Tentacular retractor muscles free from the columellar muscle throughout.

This family is confined to the Hawaiian Islands, with the exception of the genus *Fernandezia* from Juan Fernandez, now placed here provisionally. No other forms, living or fossil, are known from other regions. It is rather remotely related to the *Partulidæ*, more closely to the *Ferussacidæ*; and the minute *Tornatellinidæ* are probably not distant. Two very strongly differentiated subfamilies exist.

ACHATINELLINÆ, arboreal forms, usually with light or bright-colored shell, the sculpture of embryonic shell spiral when present, jaw extremely thin, teeth of peculiar shape and in v-shaped transverse rows (see vol. XXII).

AMASTRINÆ. Mainly terrestrial snails with less conspicuous coloration, the apical sculpture generally axial when present, jaw stronger, teeth (see p. 129) resembling those of *Achatinidæ*, in nearly straight, transverse rows.

Key to Genera of Amastrinæ.

a. Oviparous; shell ovate-conic or oblong-conic, glossy, rather small (5 to 15 mm.), the apex obtuse, rounded.

b. Forms from Juan Fernandez. Genus FERNANDEZIA, p. 93.

*b*¹. Hawaiian forms. Genus LEPTACHATINA, p. 1.

*a*¹. Viviparous.

b. Shell Heliciform, much wider than high, umbilicate.

c. Embryonic whorls projecting, convex, last

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whorl descending in front; peristome expanded; no columellar lamella.

Genus ARMSIA, p. 132.

c^1. Embryonic whorls flattened.

d. Planorboid; no columellar lamella; umbilicus very wide.

Genus PLANAMASTRA, p. 129.

d^1. Biconvex, fragile, umbilicus moderate or small, contained 4 to 10 times in the diameter; columellar lamella more or less strongly developed.

Genus PTERODISCUS, p. 118.

b^1. Shell globose-conic, ovate or columnar.

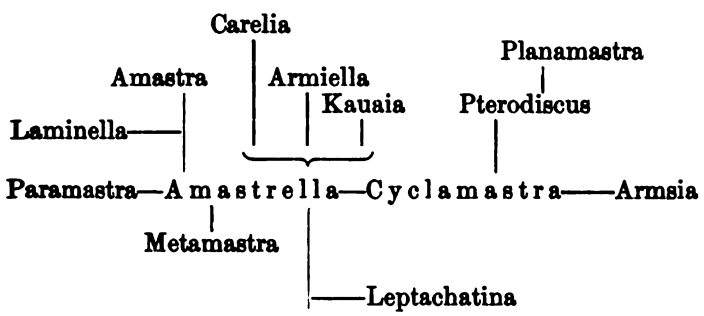
c. Shell imperforate, columnar or oblong, rather large (length 25 to 75 mm.), solid, with convexly conic summit of flat whorls; columellar lamella small; usually dark-colored.

Genus CARELIA, p. 100.

c^1. Shell umbilicate, perforate or closed, usually ovate-conic, but varying from globose-conic to turrited; usually dull-colored and dextral; living on the ground. Genus AMASTRA, p. 133.

c^2. Shell usually perforate, ovate or turrite, yellow, pink or whitish, sometimes uniform, but usually with zigzag black stripes or dots; columellar lamella strong. Living on plants, never on the ground.

Genus LAMINELLA, p. 323.



Approximate Phylogeny of Genera and Subgenera of Amastrinæ.

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DISTRIBUTION OF GENERA, SUBGENERA AND SPECIES OF AMASTRINÆ.

	FERNANDEZIA.	LEPTACHATINA.				CARELIA.	AMASTRA.							LAMINELLA.	ARMSIA.	PTERODISCUS.	PLANAMASTRA.
		Leptachatina.	Pauahia.	Thaanumia.	Iiikala.		Armiella.	Kauaia.	Cyclamastra.	Amastrella.	Metamastra.	Paramastra.	Amastra.	Heteramastra.			
Niihau	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Kauai	.	20	.	1	1	10	1	1	3	3	.	.	.	.	.	.	.
Oahu	.	45	3	3	2	.	.	.	4	10	23	11	.	.	1	7	1
Molokai	.	8	.	2	.	.	.	.	1	2	.	.	12	2	.	.	.
Maui	.	14	.	1	.	.	.	.	3	.	.	.	13	5	.	.	.
Lanai	.	8	.	.	.	.	.	.	.	.	.	.	8	1	.	1	.
Hawaii	.	8	.	1	.	.	.	.	.	6	.	.	.	1	.	.	.
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SECOND SERIES: PULMONATA.

MANUAL

OF

CONCHOLOGY

STRUCTURAL AND SYSTEMATIC

WITH ILLUSTRATIONS OF THE SPECIES

FOUNDED BY

GEORGE W. TRYON, JR.

CONTINUED BY

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Part

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AUG ... '0

Genus LEPTACHATINA Gould, 1847.

BY C. MONTAGUE COOKE, BISHOP MUSEUM, HONOLULU, H. I.[1]

Leptachatina GLD., Proc. Boston Soc. Nat. Hist. ii, 1847, p. 201; U. S. Exp. Exp. Moll., 1852, p. 88.—PFEIFFER, Malak. Blätter, 1854, p. 143; Mon. Hel. Viv., iv, p. 563.—HARTMAN, Proc. A. N. S. Phila., 1888, p. 51.—H. and A. ADAMS, Gen. of Rec. Moll., ii, p. 139.—PEASE, P. Z. S. London, 1869, p. 650.—GULICK, P. Z. S., 1873, p. 91.—BALDWIN, Cat. Hawaiian Shells, 1893, p. 10.—SYKES, Fauna Hawaiiensis, ii, Mollusca, 1900, p. 356.

Amastrinæ with a rather small ovate or turrite shell, usually imperforate, sometimes perforate, rarely umbilicate; usually glossy, sometimes of a silky luster; smooth, striate or costate; the embryonic whorls are usually smooth (subgenera *Leptachatina s. s.*, *Labiella* and *Pauahia*), sometimes striate with minute spiral striae (subgenus *Thaanumia*) and sometimes costate with longitudinal (axial) costæ (subgenus *Ilikala*); the apex is always blunt and rounded; the aperture is slightly oblique; the columellar fold is usually rather weak, lamellate, the lamella sometimes reduced to a faint raised line, usually oblique, rarely subtransverse. The animals are oviparous.

Type *L. acuminata* Gld. Distribution, Hawaiian Islands, living on the ground (with the exception of *L. arborea*).

The shells of *Leptachatina* are easily separated from those of *Amastra*. In the latter genus the apex is more acute, never rounded, and usually minutely striate. *Amastra* is viviparous.

Leptachatina was proposed by Gould in a note under the description of *acuminata*, in the following words: "The clear

[1] The present paper is based on a study of the collections of the British Museum, the Smithsonian Institution, the Academy of Natural Sciences of Philadelphia, the Boston Society of Natural History, the Museum of Comparative Zoology, the New York State Museum and the Museum of Cornell University. I wish to express my thanks to the gentlemen in charge of the different collections, especially to Dr. H. A. Pilsbry, under whom this paper was prepared.—C. M. C.

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delicate species like this, with the mere semblance of a columellar fold, may properly constitute a distinct group, to which the name *Leptachatina* (*leptos* and *Achatina*) might be given." In 1852 Gould included three additional species (*cerealis, guttula* and *accincta*).

Pfeiffer in his numerous writings employed *Leptachatina* only as a section of *Achatinella*. Hartman (1888) also considered *Leptachatina* as a section of *Achatinella*. H. & A. Adams accorded *Leptachatina* subgeneric rank.

Pease was the first author to use *Leptachatina* as a genus. Since then several authors have considered *Leptachatina* to be a separate genus. Baldwin, Ancey and Sykes have taken this view, which is supported by the differential features of the shell no less than by the oviparous reproduction.

Classification of species.

Leptachatina may be divided into several groups according to the form of the shell, the closeness of the whorls, and other characters noticed below.

I. Embryonic whorls smooth.

1. Aperture simple. Subgenus LEPTACHATINA s. str.

a. Surface smooth, nearly smooth, or slightly striate.

A. The shells are elongate or acuminate; the aperture more or less angulate at both ends.

Group of L. acuminata, species 1-4.

B. The shells are small, slender, somewhat turrited, glossy, transparent; aperture more or less rounded below.

Group of L. sandwicensis, species, 5-12.

C. The shells are small, slightly striate, usually dark chestnut, somewhat turrited and slightly thicker than those of B.

Group of L. cerealis, species 13-17.

D. The shells are larger than those of B and C, turrited; the upper whorls closely coiled.

Group of L. gracilis, species 18-20.

E. The shells are small, slender, subcylindrical,

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smooth, glossy, thin; the last two whorls increasing rather rapidly.

Group of L. obsoleta, species 21-28.

F. The shells are small, ovate or ovately conic, smooth, pellucid or subpellucid.

Group of L. accincta, species 29-51.

G. The shells are slightly larger and thicker than those of F. Group of L. nitida, species, 52-58.

H. The shells are broadly ovately conic or conic, larger than those of G.

Group of L. glutinosa, species 59-63.

I. The shells are perforate, distinctly striate, narrowly ovate.

Group of L. semipicta, species 64.

J. The shells are striate, broadly ovate-subcylindrical, nearly solid.

Group of L. pachystoma, species 65.

K. The shells are rather large (for the genus), elongately ovate, nearly solid.

Group of L. ventulus, species 66-72.

L. The shells are rather large (for the genus), subelliptical, nearly solid.

Group of L. succincta, species 73-77.

M. The shells are umbilicate, with a strong raised callus on the parietal wall.

Group of L. fossilis, species 78.

aa. Surface distinctly costulate or costate.

N. The shells are small, slender, costulate or costate. Group of L. sculpta, species 79-90.

O. The shells are larger than those of N, glossy, costate. Group of L. striatula, species 91-99.

2. Aperture usually furnished with a denticle or indication of a denticle within the outer lip; spire slightly concave in outline.

Subgenus LABIELLA, species 100-103.

3. Aperture usually furnished (in young shells) with a palatal lamina; shells cylindrical.

Subgenus PAUAHIA, species 104-106.

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II. Embryonic whorls spirally striate.
Subgenus THAANUMIA, species 107-114.

III. Embryonic whorls transversely costate or striate.
Subgenus ILIKALA, species 115-117.

Distribution of species.

KAUAI.

Group A: acuminata, cuneata, antiqua, lævis.
B: knudseni.
E: cylindrata.
F: brevicula.
J: pachystoma.
M: fossilis.
N: lucida, striata.
O: attenuata, gayi, tenebrosa, leucochila, costulosa, pupoidea, extensa, striatula, balteata.
Thaanumia: perforata.
Ilikala: fraterna.

OAHU.

Group B: sandwicensis, stiria, illimis, scutilis.
C: cerealis, obtusa? teres, turrita, persubtilis.
D: gracilis, subula, terebralis.
E: convexiuscula, exilis, saxatilis, leiahiensis, exoptabilis.
F: accincta, crystallina, gummea, oryza, vana, capitosa, pulchra, ovipara.
G: fumida.
H: glutinosa, dimidiata, pyramis.
K: cingula, ventulus, approximans, pilsbryi.
L: corneola, marginata, resinula, succincta, saccula?
N: costulata, octogyrata, sculpta, semicostata.
Labiella: labiata, callosa, lagena.
Pauahia: artata, tantilla, chrysallis.
Thaanumia: omphalodes, optabilis, fuscula.
Ilikala: fusca, petila.

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MOLOKAI.

Group B: lævigata.
E: molokaiensis.
F: emerita, concolor, conicoides, varia.
G: coruscans.
N: lanceolata.
Thaanumia: thaanumi, morbida.

MAUI.

Group B: fulgida, baldwini.
E: obsoleta.
F: guttula, ovata, vitreola, grana.
G: nitida, compacta, isthmica, præstabilis.
H: kuhnsi.
K: conspicienda.
Labiella: lenta.
Thaanumia: dulcis.

LANAI.

Group F: subovata.
H: smithi.
I: semipicta.
K: perkinsi, longiuscula.
N: impressa, supracostata, lanaiensis.

HAWAII.

Group F: arborea, simplex, anceyana, defuncta, lepida.
G: konaensis.
N: imitatrix, tenuicostata.
Thaanumia: henshawi.

Subgenus LEPTACHATINA *s.s.*

A. *Group of L. acuminata.*

1. L. ACUMINATA (Gould). Pl. 7, fig. 41.

"Shell small, slender, turreted, elongated, with an obtuse apex, translucent, thin, very smooth and shining, of a greenish amber-color. Spire elevated, obtuse, pointed, of six

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very oblique, slightly convex whorls, the last of which is nearly two-thirds the length of the shell. Suture distinct, and faintly margined and crenulated. Aperture very narrow, one-third the length of the shell, rounded at base, and acute behind. Lip simple, whitish, thickened within, and arching forward. Columella without a conspicuous fold bordering the truncation. Length ½, diam. ⅛ inch (12.5 x 3.1 mm.)." (*Gld.*)

Kauai (U. S. Expl. Exped.).

Achatinella acuminata GOULD, P. Bost. Soc., ii, 1848, p. 200; U. S. Expl. Exped., Moll., 1852, p. 87, pl. vii, figs. 100, 100a.—*Achatinella* (*Leptachatina*) *acuminata* PFEIFFER, Mon. Hel. Viv., iv, 6, 566.—*Leptachatina acuminata* PEASE, P. Z. S., 1869, p. 650.—SYKES, Fauna Haw., ii, Moll., p. 357, pl. xii, figs. 13, 13a (radula).

This species, the type of the genus, unfortunately is represented by a single broken shell in the collection of the Smithsonian Institution. A careful search through Gould's collection, in Albany, did not produce another specimen.

The species seems to be entirely distinct from any other species, and does not seem to have been rediscovered since the original material was collected. Specimens belonging to *L. attenuata* have been distributed by later collectors as this species, but the two are separable. *L. acuminata* (according to Gould's figure) is smoother, narrower in proportion to its length, the spire is more shortly conic, the sutures more oblique and the aperture is narrower and longer. *L. cuneata* may be a possible relative.

L. acuminata is probably a very local species and may ultimately be found somewhere in the northeastern district of Kauai, where very little collecting, if any, has been done. Gould's figure is copied in fig. 41.

2. L. CUNEATA n. sp. Pl. 10, figs. 1, 2.

The shell is imperforate, conic, corneous, thin, subdiaphanous, glossy, indistinctly striate. Spire conic, apex somewhat obtuse. Suture hardly impressed, very minutely crenulate. Whorls 6⅔, the upper flat, gradually becoming slightly con-

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vex, increasing regularly, the last tapering slowly to the base. Aperture rather large, subovate, whitish within, hardly oblique, perpendicular, ascending slightly in front. Columella very slightly twisted, with an oblique rather weak fold and a slight thickening along its face. Outer lip very slightly thickened within, regularly arcuate; columellar margin slightly thickened, appressed, adnate. Length 10.5, diam. 4.8, length of aperture 4.2 mm.

Kauai: Kapaa (Baldwin).

A very distinct species, with no closely related species from the island of Kauai. *L. acuminata*, Gould, may possibly prove to be a distant relative. It is, however, much narrower in proportion to its length, with a narrower and more elongate aperture.

3. L. ANTIQUA Pease. Pl. 8, figs. 60-62.

"The shell is subfossil, oblong subcylindrical, solid, scarcely rimate, longitudinally faintly striate; whorls 7, flatly convex, narrowly margined at the suture; spire somewhat obtuse; aperture oblong oval; columella obliquely truncate; columellar fold obsolete. Length 9.0, diam. 3.5 mm." (*Pse.*)

Kauai (Pease): Koloa beach (Judd).

Leptachatina antiqua PEASE, P. Z. S. L. 1869, p. 651 (nom. sol.); Journ. de Conchyl., XVIII, 1870, p. 94.—CROSSE, Journ. de Conchyl., 1876, pl. 3, fig. 6.—*Achatinella* (*Leptachatina*) *antiqua* PFR., Mon. Hel. Viv., viii, p. 247.

The shells collected by Mr. Judd (Pl. 8, figs. 60, 61) agree fairly well with Pease's description. One of his shells measures, length 9.0, diam. 3.8, length of aperture 3.7 mm. A larger form of this species was found in the same locality. It agrees in all its characters except size, a specimen measuring: length 12.0, diam. 5.3, length of aperture 5.4 mm: This species may be distantly related to *L. lævis* Pse. Pease's original figure is copied, fig. 62.

4. L. LAEVIS (Pease). Pl. 8, figs. 56, 57.

"The shell is ovately oblong, imperforate, dextral, somewhat thin, smooth, glossy, brown; whorls 7, somewhat flat,

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scarcely marginate at the suture; aperture almost vertical, elongately ovate; columella arcuate; columellar fold compressed, twisted, almost transverse; lip scarcely thickened, brown. Length 9.0, diam. 4.0 mm." (*Pse.*)

Kauai (Pease): Haleieie, at 1500 and 1700 ft. (Cooke).

Leptachatina lævis PEASE, P. Z. S., 1869, p. 651 (nom. sol.); Journ. de Conchyl. xviii, 1870, p. 91.—CROSSE, Journ. de Conchyl. xxiii, 1876, pl. iv, fig. 6.—*Achatinella* (*Leptachatina*) *lævis* PFR., Mon. Hel. Viv., viii, p. 245.

Typical examples, from the higher elevation, are very slightly larger than Pease's type. A fine example measures: length 9.6, diam. 4.2, length of aperture 4.3 mm. Those from the lower elevation are smaller, thinner, lighter-colored and more cylindrical in outline. They measure length 7.6, diam. 3.5, length of aperture 3.5 mm. This species is very distinct from any other Kauaian species. The dark color, smooth and very glossy surface being most characteristic. This species is not closely related to *L. fusca* Newc., as Pease supposed. The original figure is copied in fig. 56.

B. *Group of L. sandwicensis.*

5. L. KNUDSENI n. sp. Pl. 9, figs. 11, 12.

The shell is imperforate, elongate, turrited, corneous, thin, diaphanous, glossy, smooth, under a lens minutely and irregularly striate with lines of growth. Spire turrited, apex blunt. Suture lightly impressed, very finely margined. Whorls 8, very slightly convex, compact, the last subrectilinear in outline, somewhat tapering at the base. Aperture ovate-pyriform, nearly perpendicular, very slightly oblique. Columella slightly arcuate above, not truncate, with a very minute fold deep within. Outer margin of lip erect, slightly thickened within, slightly arcuate; columellar margin white, slightly thickened, appressed. Length 6.3, diam. 2.2, length of aperture 2.0 mm.

Kauai: Waipo, near Halemanu, at an altitude of 3500 ft., Ekaula, alt. 1900 ft. (Cooke).

This species' nearest relative is *L. lucida* Pse., from the

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same island. It differs in being more slender and without costæ. *L. lucida* is straw color, while *L. knudseni* is corneous with a slight yellowish tinge. The species is not abundant. It was found under ferns among the moist rotting leaves.

6. L. SANDWICENSIS (Pfeiffer). Pl. 9, figs. 7, 8.

"Shell ovately conic, obliquely striate, subopaque, dirty corneous; spire conic, somewhat obtuse; suture marginated with an impressed line; whorls 6½, somewhat flat, the last scarcely more than ⅓ of the length; columella arcuate, plicately twisted, aperture broad, semioval lip simple, dextral margin obtuse, columellar margin subreflexed, appressed. Long. 7, diam. 3.5 mm." (*Pfr.*). "Long, 7.75, diam. 3 mm." (*Pfr.*, for *obclavata*).

Oahu: Waianae Mts. (Perkins); back of Leilehua (Cooke). ? Molokai (Borch.).

Achatina sandwicensis PFR., P. Z. S., 1846, p. 32.—*Achatina accincta* RVE., Conch. Icon., Achatina sp. 101.—Pfr. Mon. Hel. Viv., ii, p. 271.—*Achatinella obclavata* PFR., P. Z. S., 1855, p. 98.—*Achatinella* (*Leptachatina*) *octavula* Paetel, CLESSIN, Nomen. Helic. Viv., 1881, p. 316.—*Leptachatina sandwichensis* and *obclavata* Pse., P. Z. S., 1869, p. 650.—SYKES, Fauna Haw., ii, p. 368; Borcherding, Zoologica, part 48, p. 130, pl. ix, fig. 13.

From an examination of the types I agree with Mr. Sykes' synonomy of this species, as *sandwicensis* and *obclavata* are no doubt forms of the same species. Specimens in the Bishop Museum Collection which I have referred to this species are slightly larger than typical forms of *L. sandwicensis* and approach the form of *L. obclavata*. The average length, of specimens from back of Leilehua, is 7.8, diam. 3.25, altitude of aperture 3.2 mm., they are corneous with a brownish tinge.

7. L. STIRIA (Gulick). Pl. 9, fig. 9.

"Shell dextral, perforate, elongate, thin, shining, pellucid, vitreous, very finely striated; apex obtuse; spire turreted; suture simple, slightly impressed; whorls 6½, somewhat convex; columella very lightly plaited deep within the aperture;

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aperture pyriform; peristome simple, thin; with dextral margin unreflected, lightly arcuate; columellar margin reflected, not appressed; parietal margin very thin, vitreous. Length 7, diam. 2.8 mm. Body whorl 4 mm. long." (*Gul.*)

Oahu: Helemanu, Peula, Kawailoa (Gulick); Waianae Mts. back of Leilehua (Cooke).

Achatinella stiria GULICK, Ann. Lyc. N. Y., vi, 1856, p. 194, pl. 6, fig. 22.—*Achatinella* (*Leptachatina*) *stiria* PFR., Mon. Hel. Viv., vi, p. 187.—*Leptachatina stiria* HARTMAN, Proc. A. N. S. Phila., 1888, p. 55.

This species is related to the shell which I have referred to as *L. sandwicensis*. The shell is narrower in proportion to its length, spire slenderer, and the surface is slightly more striate. Figured from a cotype.

8. L. ILLIMIS n. sp. Pl. 10, fig. 3.

The shell is minutely perforate, elongate, light corneous, thin, glossy, subdiaphanous, nearly smooth, under a lens minutely and regularly striate. Spire elongate, attenuate, apex blunt. Suture simple, hardly impressed. Whorls 7, the embryonic rounded, very smooth and polished, the neanic flat, closely coiled, increasing slowly, the last two whorls slightly convex, the last nearly cylindrical, tapering towards the base. Aperture narrowly ovate, acute above, slightly oblique, perpendicular. Columella very slightly arcuate, with a slightly thickened callus along its face, and a rather small oblique fold. Outer lip nearly straight, erect, very minutely thickened within, columellar margin reflexed, adnate for about ½ of its length. Umbilicus very minute. Length 7.6, diam. 2.9, length of ap. 2.8 mm.

Oahu: Palehua in the Waianae Mts. (Cooke).

This species is closely related to *L. stiria* Gulick. It differs, however, in being less distinctly striate, slightly larger, and the columellar fold is stronger and less oblique.

9. L. SCUTILUS (Mighels). Pl. 9, figs. 3, 4.

"Shell dextral, cylindrical, turreted, white, polished, imperforate; whorls 6, convex; aperture elongate oval; lip sim-

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ple, acute. Length 7/30, diam. 3/35 inch." (5.8 x 2.1 mm.) (Migh.)

Oahu (Migh.): Waianae Mts. at Palehua and back of Leilehua (Cooke).

Bulimus scutilus MIGH., Proc. Bost. Soc. N. H., ii, 1845, p. 20.—PFR., Mon. Hel. Viv. ii, p. 165.—*Leptachatina scutilus* PEASE, P. Z. S., 1869, p. 650.

It is with some hesitation that I refer shells to this species. Mighel's description is incomplete and the types were probably lost in the fire which destroyed part of his collection as no trace can be found of this species. The shells which I have referred to this species are imperforate, elongately turrited, corneous or slightly brownish corneous, thin, diaphanous, smooth, glossy. Spire turrited, subcylindrical, apex obtuse. Suture simple, slightly impressed. Whorls 7, nearly flat, the last subcylindrical, slightly tapering at the base; aperture elongately oval, slightly oblique, nearly perpendicular; columella nearly straight, slightly twisted, with a very minute oblique fold; outer lip erect, thin, nearly straight above, below arcuate; columellar margin thin, reflexed, adnate.

This species recalls *L. convexiuscula* Sykes. The shell is slightly smaller, with less convex outlines, the whorls are more evenly coiled and the last two increase more slowly, the aperture is smaller and more perpendicular. My specimens are slightly larger than Mighel's measurements and have an additional whorl. The measurements of an average specimen are: Length 7.0, diam. 2.3, alt. of ap. 2.3 mm.

10. L. LÆVIGATA n. sp. Pl. 6, figs. 4, 5.

The shell is imperforate, elongately conic, slightly attenuate, reddish brown above the periphery and yellowish corneous below, subdiaphanous, glossy, smooth, under a lens indistinctly striate with lines of growth. Spire acutely conic, apex obtuse. Suture lightly impressed, narrowly margined, marked with a narrow dark brown band. Whorls 6½, slightly convex, the last subcylindrical, tapering towards the base. Aperture subovate, slightly oblique, perpendicular. Columella nearly straight, with a very minute, deeply situ-

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ated, almost perpendicular lamella. Outer lip slightly arcuate, columellar margin reflexed, adnate. Length 7.6, diam. 3.5, length of ap. 3.1 mm.

Molokai: Mapulehu Ridge (Thaanum).

There is a unicolorous brownish corneous variety, which has the columellar fold more strongly developed.

This species is somewhat related to *L. lanceolata*. It is, however stronger and stouter, and differs in its color pattern.

11. L. FULGIDA n. sp. Pl. 2, figs. 39, 40.

The shell is imperforate, elongately ovately conic, greenish yellow, except the whitish embryonic whorls, rather thin, hardly diaphanous, glossy, very smooth, under a strong lens hardly striate. Spire elongate, subconic, apex subobtuse. Suture slightly impressed, narrowly margined, accompanied with a very narrow reddish line. Whorls 6½, the embryonic convex, the third and fourth nearly flat, the last two slightly convex, the first 4½ closely coiled, the last two increasing more rapidly, the last subcylindrical, tapering to the base. Aperture subovate, slightly oblique, nearly perpendicular. Columella nearly straight, purplish, with a rather small oblique lamella. Outer lip dark brown, arcuate, slightly thickened within; columellar margin adnate. Length 6.9, diam. 2.9, length of ap. 2.8 mm.

West Maui: Mt. Lihau, Mt. Kukui, Akau-ka-imu, Ahoa (Thaanum).

A beautiful glossy shell related to *L. grana* Newc., but smoother, more glossy, with a more elongate spire, of which the upper whorls are flatter and more closely coiled.

From *L. baldwini* it differs in size, its smoother and more glossy surface; the shell is thicker, and the last two whorls increase more rapidly.

12. L. BALDWINI n. sp. Pl. 2, figs. 33, 41.

The shell is minutely perforate, elongately turrited, corneous, thin, subdiaphanous, minutely striate, especially below the suture. Spire elongately conic, apex obtuse. Suture scarcely impressed, crenulate, not margined. Whorls 6¾,

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hardly convex, increasing slowly and regularly, the upper closely coiled, the last subcylindrical, tapering to the base. Aperture subovate, slightly oblique and very slightly diagonal. Columella nearly straight, with a very small oblique deeply situated lamella. Outer lip quite strongly arcuate, slightly thickened within, indistinctly edged with dark brown; columellar margin adnate above, reflexed. Umbilicus minute. Length 6.3, diam. 2.6, length of ap. 2.6 mm.

West Maui Maunahoomaha (Thaanum, Cooke); Mt. Lihau, Honokowai Gulch and Akau-ka-imu (Thaanum); Lahaina (Baldwin). East Maui: Kailiili (Baldwin).

Of the species from Maui, *L. grana* Newc. seems to be its closest relative. *L. baldwini* is, however, minutely perforate, shorter with nearly an additional whorl; the whorls are more closely coiled and flatter; the spire is less convex in outline; the aperture is smaller, etc.

C. *Group of L. cerealis.*

13. L. CEREALIS (Gould). Pl. 11, fig. 7.

"Shell small, elongate, cylindrically conical, unpolished, ashy chestnut, spire obtuse, whorls 7-8, nearly flat, the last hardly more than one-third of the length; aperture small, lunate, equal to a fourth of the length; lip simple, thickened within; columellar fold obsolete, the penultimate whorl covered with callus. Length 3/8, diam. 1/8 inch." (9.6 x 3.2 mm.) (*Gould*).

Oahu Waianae (Gould, Perkins).

Achatinella cerealis GOULD, Proc. Bost. Soc., ii, 1847, p. 201; U. S. Exp., Moll., pl. vii, fig. 99, 99a.—PFEIFFER, Mon. Hel. Viv., iii, p. 466.—*Achatinella* (*Amastra*) *cerealis* PFEIFFER, Mon. Hel. Viv., iv, p. 545; vi, p. 178; viii, p. 235.—HARTMAN, Proc. A. N. S., Phila., 1888, pl. i, fig. 13.—*Leptachatina cerealis* PSE., P. Z. S., 1869, p. 651.—SYKES, Fauna, Haw., ii, 1900, p. 358.

Among several more or less slender species from Waianae I have been unable to find a single specimen which agrees closely with Gould's type.

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14. L. OBTUSA ('Newcomb' Pfeiffer).

"Shell imperforate, oblong, nearly smooth, glossy, pellucid, chestnut-corneous; spire cylindrically turrited, apex obtuse; suture submarginate; whorls 6½, nearly flat, the last nearly equal to ⅖ of the length; aperture vertical, acuminately oval, subangulate at the base; columellar fold small, oblique; lip simple, erect, with a pale edge, the margins united by a thin callus. Length 10.0, diam. 4.0, length of apert. 4.0, diam. 2.0." (Pfeiffer.)

Oahu (Newcomb coll.).

Achatinella obtusa (Newcomb) PFEIFFER, P. Z. S., London, 1855, p. 209.—*Achatinella* (*Leptachatina*) *obtusa* PFEIFFER, Mon. Hel. Viv., iv, p. 567.—*Leptachatina obtusa* PEASE, P. Z. S., London, 1869, p. 651.—SYKES, Fauna Haw., ii, Moll., p. 366.

A dark brown, subcylindrical shell, with a thick, well-developed lip. This species does not seem to be closely related to any of the other species of the genus. The only specimens which I have seen so far are in the collection of the British Museum and that of Newcomb.

✓ 15. L. TERES (Pfeiffer).

"Shell imperforate, dextral, cylindrically oblong, somewhat thin, lightly striate, very glossy, corneous; spire gradually attenuate, apex somewhat obtuse; suture crenulate, dark chestnut, on the last whorl impressly marginate; whorls 7, somewhat flat, the last a little more than ⅓ of the length, slightly ascending in front; aperture suboblique, sinuately semioval; columellar fold subcallous, twisted, oblique; lip simple, erect. Length 10, diam. 4 mm." (*Pfr.*).

Hawaiian Islands (Pfeiffer); probably Oahu.

Achatinella (*Leptachatina*) *teres* PFR., P. Z. S., 1855 (1856), p. 206; Mon. Hel. Viv., iv, p. 566.—*Leptachatina teres* PSE., P. Z. S., 1869, p. 651.—SYKES, Fauna Haw., ii, p. 371.

This species is very closely related to *L. obtusa* and the two may ultimately prove to belong to the same species. The type

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specimen of *L. teres* is an obtuse, subcylindrical shell, quite thick (for the genus), with a vertical aperture which does not extend beyond the penultimate whorl.

16. L. TURRITA (Gulick). Pl. 9, fig. 16.

"Shell dextral, imperforate, ovately turrited, rather thin, shining, translucent, dark corneous, finely striated; apex obtuse, pallid; spire turrited; suture simple, lightly impressed; whorls nearly 9, flatly convex; columellar fold moderately developed, whitish; aperture roundly lunate; peristome simple; with dextral margin unreflected, arcuate; columellar margin dilated, thin, adnate; parietal margin wanting. Length 9, diam. 4 mm. Body whorl 5 mill. long." (*Gul.*).

Oahu: Mountain ravines of Lihue (Gulick).

Achatinella turrita GUL., Ann. Lyc. N. Y., vi, 1856, p. 192, pl. 6, fig. 20.—*Achatinella obclavata* (= *L. sandwicensis* Pfr.), NEWC., Ann. Lyc. N. Y., 1858, p. 322.—*Leptachatina turrita* BALD., Cat. Haw. Shells, 1893, p. 12.—SYKES, Proc. Mal. Soc. Lond., iii, pl. 14, fig. 6; Fauna Haw., ii, p. 372.

I have only seen the type specimens, and agree with Mr. Sykes that this species is not *obclavata* (= *sandwicensis* Pfr.) to which species it was referred by Newcomb. Mr. Sykes' figure of the type is copied.

17. L. PERSUBTILIS n. sp. Pl. 10, fig. 4.

The shell is imperforate turrited, nearly corneous, diaphanous, thin, glossy, very finely and closely striated. Spire turrited, apex rather blunt, rounded. Suture distinctly margined, scarcely impressed. Whorls nearly 8, almost flat, closely coiled, increasing slowly and regularly, the last cylindrical, tapering towards the base. Aperture subovate, slightly oblique, perpendicular. Columella nearly straight, its face slightly concave, columellar fold rather strong, thin, nearly median. Outer margin of lip regularly curved, erect, slightly thickened within; columellar margin thin, appressed, adnate; parietal wall covered with a thin, closely striated callus. Length 8.7, diam. 3.6; length of ap. 3.5 mm.

Oahu: Waianae Mts. back of Waialua (Lyman).

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L. persubtilis is chiefly characterized by its turrited form, almost flat whorls and the minute striation on the callus of the parietal wall. Some of the specimens have a light brownish tinge which is somewhat lighter near the suture. I know of no species to which it may be closely related.

D. *Group of L. gracilis.*

18. L. GRACILIS (Pfeiffer). Pl. 3, figs. 47, 48.

"Shell, imperforate, slender, turrited, somewhat solid, nearly smooth, white, encircled with two brown bands; spire elongate, regularly attenuate, apex somewhat obtuse; suture simple; whorls 8, somewhat flat, the last equal to ⅓ of the length, rotundate at the base; aperture subvertical, sinuately oval; columellar fold median, subcompressed; lip simple, dextral margin erect, lightly arcuate, columellar margin dilated, adnate. Length 14.0, diam. 5.5 mm." (*Pfr.*).

Oahu: Waianae Mts.; Kaala (Baldwin); below Kaala (Perkins); back of Waialua (Lyman); back of Leilehua (Cooke).

Achatinella gracilis PFEIFFER, P. Z. S., 1855, p. 6, pl. 30, fig. 22.—*Achatinella elevata* Newcomb, PFEIFFER, P. Z. S., 1855 (1856), p. 209.—*Achatinella* (*Achatinellastrum*) *gracilis* PFEIFFER, Mon. Hel. Viv., iv, p. 536; vi, p. 173; viii, p. 224.—*Leptachatina gracilis* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 321.—SYKES, Fauna Haw., ii, 1900, p. 363.

A very distinct elongate species. None of my specimens approach Pfeiffer's in size. The shells from the western extremity of the Waianae range have a longer and narrower aperture than those from near the middle of the range. Measurements of specimens from these two localities are:

Length 11.8, diam. 4.7, length of apert. 4.5 mm. (Back of Waialua).

Length 12.0, diam. 5.3, length of apert. 4.3 mm. (Back of Leilehua).

Pfeiffer's original figure is copied, pl. 3, fig. 48.

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19. L. SUBULA (Gulick). Pl. 9, fig. 14.

"Shell dextral, imperforate, elongate, thin, shining, translucent, dark corneous, very finely striated; apex obtuse, whitish; spire turrited; suture simple, impressed; whorls 9, convex; columellar fold central, white; aperture sinuately lunate; peristome simple; with dextral margin unreflected, arcuate; columellar margin dilated, white, adnate; parietal margin wanting. Length 11.5, diam. 4.3, length of body whorl 6 mm." (Gul.)

Oahu: Palolo (Gul.); Waialae (Spalding).

Achatinella subula GULICK, Ann. Lyc. N. Y., vi, 1856, p. 191, pl. 6, fig. 19.—*Achatinella gracilis* NEWCOMB, Ann. Lyc. N. Y., 1858, p. 321.—*Achatinella* (*Leptachatina*) *elevata* PFEIFFER, Mon. Hel. Viv., vi, p. 184.—*Leptachatina subula* SYKES, Proc. Malac. Soc. London, iii, pl. 14, fig. 16.—*Leptachatina gracilis* SYKES, Fauna Haw., ii, Moll., p. 363.

The type specimen of *L. subula* was carefully compared with specimens of *L. gracilis*, with the following differences: the spire of the former is more attenuate, almost slightly concave, the whorls are more convex; the shell is thinner, darker colored and unicolorous; the striæ are more pronounced; the apex is more acute and less rounded. Mr. Sykes' figure of the type is copied in fig. 14.

20. L. TEREBRALIS (Gulick). Pl. 9, fig. 15.

"Shell dextral, imperforate, turreted, shining, dark brown, corneous, very finely striated; apex obtuse, white; spire turreted; suture simple, slightly impressed, whorls 7½, flatly convex; columella white, moderately plaited; aperture lunate; peristome whitish; with dextral margin unreflected, somewhat thickened; columellar margin dilated; adnate; parietal margin thin. Long. 11, diam .4.5 mm. Body whorl 6 mm. long." (*Gul.*)

"Var. *b*. With spire shortened, concavely conical; body whorl rounded." (*Gul.*)

Oahu: Kawailoa (Gulick); Waianae Mts., below Kaala (Perkins).

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Achatinella terebralis GUL., Ann. Lyc. N. Y., vi, 1856, p. 193, pl. 6, fig. 21.—*Achatinella* (*Leptachatina*) *terebralis* PFR., Mon. Hel. Viv., vi, p. 185.—*Leptachatina terebralis* PEASE, P. Z. S., 1869, p. 651.—SYKES, Proc. Mal. Soc. Lond., iii, pl. 14, fig. 3; Fauna Haw., ii, p. 371.

"Resembles *A. turrita* and *subula* Nob., but is thicker and heavier than either, and has fewer whorls. The shorter variety seems to revert to the form of *A. lagena* Nob., which in geographical relation is within five or six miles, and in affinity is probably more nearly allied to this than are *A. turrita* and *subula*, found in more distant parts of the island. The number of its whorls and its thicker structure favor this opinion." (*Gulick.*)

L. terebralis seems to be also related to *L. gracilis* Pfr. It is slightly narrower in proportion to its length and the spire is more turrited. Mr. Sykes' figure of the type is copied in fig. 15.

E. *Group of L. obsoleta.*

21. L. CYLINDRATA Pease. Pl. 8, figs. 63, 64.

"The shell is thin, dextral, glossy, imperforate, elongate, subcylindrical, longitudinally faintly striate, scarcely crenulate at the suture, yellowish corneous; whorls 6, nearly flat, the last equal to 3/8 of the length; apex obtuse; suture impressed; columella simple, arcuate; aperture vertical, oblong ovate; lip simple. Length 8, diam. 2.5 mm." (*Pse.*)

Kauai: Kilohana, near Lihue, Waiakoali (Cooke).

Leptachatina cylindrata PEASE, Journ. de Conchyl., 1869, p. 168.—*Achatinella* (*Leptachatina*) *cylindrata* PFR., Mon. Hel. Viv., viii, p. 246.—*Leptachatina exilis* Gul., SYKES, Fauna Haw., ii, 1900, p. 361.

A shell from the former locality agrees exactly with Pease's measurements and has the aperture 2.8 mm. in length.

Mr. Sykes reduced this species to a synonym of *L. exilis* Gul. I have compared specimens of each species, sent by their respective authors to the Academy N. S. Phila., and find the following differences: *L. exilis* is smaller with the

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same number of whorls, the outlines are slightly more convex, the apex is more acute and the columellar fold is slightly stronger and more oblique. All of the shells of Gulick's species that I have been able to examine are minutely perforate, while those of Pease were imperforate. One of the specimens received from Pease is figured.

22. L. CONVEXIUSCULA Sykes. Pl. 9, figs. 1, 2, 5.

"Shell turrited, elongate, slender, somewhat thin, dextral, brownish corneous, smooth, polished, glossy, apex somewhat obtuse; whorls 6½, convex, somewhat swollen, the last equal to 9/16 of the length of the shell; suture well impressed; aperture pyriform, sinuate at the margin of the columella, furnished with a very small fold, with the margins united by a very thin callus. Length 8.0, diam. 2.8 mm." (*Sykes*).

Oahu: Waiolani (Perkins); Nuuanu, Palolo (Cooke).

Leptachatina convexiuscula SYKES, Fauna Hawaiiensis, ii, 1900, p. 360, pl. xi, fig. 11.

"A shell of the group of *L. exilis* Gulick, but with more inflated whorls, slightly more tapering towards the apex, and the mouth more drawn out to the right." (*Sykes*). Fig. 5 is a copy of the original figure. Figs. 1, 2 are from Nuuanu specimens.

L. convexiuscula is about midway between *L. cylindrata* Pse., from Kauai, and *L. exilis* Gulick. There are two color varieties among the specimens from Nuuanu. The more abundant form is brownish corneous, the other vitreous and diaphanous. The specimens from Palolo are slightly more slender than those from Nuuanu, the upper whorls of the spire are more attenuate, more closely coiled and slightly more convex; the aperture is also narrower.

Two shells from the additional localities have the following measurements: Length 8.9, diam. 2.9, alt. of apert. 3.2 mm., 6⅔ whorls (Nuuanu). Length 9.0, diam. 2.7, alt. of apert. 3.2 mm., 7 whorls (Palolo).

23. L. EXILIS (Gulick). Pl. 9, figs. 6, 10.

"Shell dextral, subperforate, cylindrically turreted, slen-

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der, very thin, shining, transparent, vitreous, scarcely striated beneath the lens; apex somewhat obtuse; spire turretly elongate; suture simple, scarcely impressed; whorls 6, somewhat flattened; columellar fold slightly developed, terminating deep within the aperture; aperture vertical, truncately elliptical; peristome simple, thin, with dextral margin unreflected, arcuate; columellar margin dilated, thin, vitreous, not appressed; parietal margin wanting. Length 6.3, diam. 2.5, length of body whorl 4.0 mm.

Oahu: Keawaawa, under stones in places not shaded by trees (Gulick).

Achatinella exilis GULICK, Ann. Lyc. N. Y., 1856, p. 188, pl. 6, fig. 16.—*Achatinella* (*Leptachatina*) *exilis* PFEIFFER, Mon. Hel. Viv., iv, p. 568; vi, p. 186; viii, p. 247.—*Leptachatina exilis* PEASE, P. Z. S. London, 1869, p. 651.—SYKES, Proc. Malac. Soc. London, iii, pl. 14, fig. 18; Fauna Haw., ii, 1900, p. 361.

A small, slender species which does not seem to be very closely related to any other species from Oahu. Its nearest relatives being *L. convexiuscula* Sykes, and *L. cylindrata* Pease, though the two are more closely allied to each other than is *exilis* to either of them. Specimens from Gulick's collection are of a brownish corneous color. Mr. Sykes believed that *cylindrata* and *exilis* belonged to the same species. From a minute and careful comparison of specimens from both authors I am inclined to differ from him. For a discussion of these differences see *L. cylindrata*.

A specimen from Mr. Gulick has the following measurements: Length 6.1, diam. 2.3, length of apert. 2.35 mm. (pl. 9, fig. 6).

24. L. SAXATILIS (Gulick). Pl. 4, fig. 76.

"Shell dextral, perforate, cylindrically oblong, thin, shining, transparent, vitreous, microscopically very finely striated; apex rather obtuse; spire elongate; suture simple, lightly impressed; whorls 6, slightly convex; the last rounded towards the aperture; columella slightly arcuate, pallid, with fold obsolete; aperture broadly oval; peristome simple, bordered

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with white; with margins joining in an unbroken curve; dextral margin unreflected, arcuate; columellar margin dilated, not appressed; parietal margin slightly callous. Length 6.3, diam. 2.8, length of body whorl 3.5 mm." (*Gul.*).

Oahu: Mokuleia, under stones in open fields. (Gul.)

Achatinella saxatilis GULICK, Ann. Lyc. N. Y., vi, 1856, p. 187, pl. 6, fig. 15.—*Achatinella* (*Leptachatina*) *saxatilis* PFR., Mon. Hel. Viv., vi, p. 186.—*Leptachatina saxatilis* PEASE, P. Z. S., 1869, p. 650.—HARTMAN, Proc. A. N. S. Phila., 1888, p. 55.—SYKES, Proc. Malac. Soc. London, iii, pl. 14, fig. 17.

"A small cylindrical species, of clear glassy appearance. It represents more nearly than any other the Oahu species, the *A. grana* Newc. (found on East Maui), from which it differs chiefly in its larger size, more elongate form, and glassy transparency. From *A. crystallina* it differs in slender form and smooth columella with umbilical cleft." (*Gulick*).

From an examination of Gulick's type of this species we find the last two whorls rapidly increasing, the columellar fold is minute and deeply seated and the lip is remarkably heavy for a shell of this type.

25. L. EXOPTABILIS n. sp. Pl. 10, figs. 5, 6.

The shell is very minutely perforate, elongate, slender, in a fossil state white, somewhat solid, under a strong lens minutely striate with lines of growth. Spire elongate, gradually tapering towards the somewhat obtuse base. Suture simple, hardly impressed, slightly oblique. Whorls 7⅔, nearly flat, slowly and regularly increasing, the last cylindrical, tapering towards the base. Aperture ovately pyriform, oblique, slightly diagonal. Columella arcuate, with a distinct callus along its face and a very minute, oblique, nearly basal fold. Outer lip almost regularly curved, erect, thickened within, columellar margin appressed and adnate for about ½ of its length. Umbilicus very minute. Length 7.8, diam. 2.6, length of ap. 2.6 mm.

Oahu: Diamond Head (fossil); Waianae Mts. back of Leilehua (Cooke).

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The description is based on two specimens one of which is not adult and is slightly broken. It is most closely related to *L. exilis* Gul. from the same island. *L. exoptabilis* is, however, larger, with less convex outlines and is narrower in proportion to its length. I have referred to this species, with some hesitation, a single shell from the Waianae Mts. The shell is larger (length 9.3, diam. 2.8, alt. of ap. 2.9 mm.), without a perforation and the columellar fold is very minute. It is very glossy and of a very light corneous color.

26. L. LEIAHIENSIS n. sp. Pl. 10, figs. 9, 10.

The shell is imperforate, elongate, turrited, white (in fossil state), smooth. Spire elongate-turrited, apex rather blunt. Suture simple, hardly impressed. Whorls 6¾, increasing regularly and very slowly, the embryonic rather large, slightly convex, the rest nearly flat, the last cylindrical with the base slightly flattened. Aperture small, subovate, rather broad in proportion to its length, oblique, slightly diagonal. Columella nearly straight, with a very minute, oblique fold. Outer margin of the lip regularly convex, thickened within, columellar margin thickened, appressed, adnate. Length 6.0, diam. 2.2; length of ap. 2.1 mm.

Oahu: Diamond Head, fossil (Cooke).

This species is distinct from all the other species. The turrited blunt spire is very characteristic of this species as is also the oblique aperture. I know of no species with which it may be closely related. It is extremely rare. Less than a dozen specimens were obtained in four trips, two of which were made especially for this species. Of all the specimens collected, only two are now unbroken, and only four were intact when collected, as the shells are very delicate and easily broken in cleaning.

27. L. MOLOKAIENSIS n. sp. Pl. 10, figs. 11, 12.

The shell is imperforate, elongate, turrited, light brownish corneous, glossy, thin, diaphanous, under a strong lens minutely striate with lines of growth. Spire elongate, tapering gradually to the rather blunt rounded apex. Suture simple,

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oblique, slightly impressed. Whorls 6, slightly convex, the embryonic rounded, the last cylindrical, tapering slowly towards the base. Aperture elongate, pyriform, oblique, perpendicular. Columella brownish, twisted, with a very oblique, minute basal fold. Outer margin of lip regularly arcuate, very slightly thickened within and faintly edged with dark brown; columellar margin thin, appressed, adnate. Length 7.3, diam. 2.8, length of ap. 2.8 mm.

Molokai: Mapulehu Ridge, Kaluaaha and Wailau Pali (Thaanum).

This species is represented by a single example from each of the above localities. *L. lanceolata* is the closest related species from Molokai. *L. molokaiensis* differs, however, in having a less number of whorls with its greater length, its smoother surface, less conic spire, etc. It is more closely related to *L. convexiuscula* Sykes from Oahu, from which it is easily recognized by its slightly less cylindrical outlines, less rapidly increasing whorls, smaller size, etc.

28. L. OBSOLETA (Pfeiffer). Pl. 2, figs. 31, 32.

"Shell subperforate, oblong-turrited, thin, very faintly striate, pellucid, glossy, pale corneous; spire slightly convexly turrited, obtuse; suture marginate; whorls 6½, slightly convex, the last forming ⅔ of the length; columella arcuate, lightly twisted at the middle; aperture scarcely oblique, elliptically oval; lip simple, columellar margin very shortly reflexed, subadnate. Length 8.0, diam. 3 mm. Aperture 3.25 mm. long, 2.0 broad." (Pfr.)

East Maui: Haleakala at 5000 feet (Perkins); floor of Haleakala crater at about 8000 feet (Cooke).

Spiraxis obsoleta PFEIFFER, Proc. Zool. Soc. London, 1856, p. 335; Mon. Hel. Viv., iv, p. 576.—*Leptachatina obsoleta* PEASE, Proc. Zool. Soc. London, 1869, p. 650.—SYKES, Fauna Haw., ii, 1900, p. 366.

An interesting species, found at a higher altitude than any other species of this genus so far reported. They were rather abundant under stones near "Crystal Cave" on the almost barren floor of the crater. Only seventeen adult specimens

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were gathered, three of which have a remarkable development. Near the base of the columella is a low blunt spiral callus on the parietal wall and extending into the aperture. This may be a senile character, though two of the specimens do not show any other signs of senility. This thickening has not been observed in any other species.

In fresh adult examples the outer lip and columella are edged with dark brown. A few have the parietal callus minutely parallel-striate. Adult specimens from a single colony vary between the following measurements: Length 7.9, diam. 3.1, length of ap. 2.9 mm. Length 8.7, diam. 3.3, length of ap. 3.3 mm. Length 8.8, diam. 3.4, length of ap. 3.2 mm.

This species is related to *L. exilis* Gul. and *L. convexiuscula* Sykes, both of which come from the island of Oahu.

F. *Group of L. accincta.*

29. L. BREVICULA Pease. Pl. 8, fig. 54.

"Shell dextral, somewhat thin, imperforate, pyramidal or shortly ovate, very minutely, longitudinally striate, corneous; whorls 5-6, somewhat flat, marginate at the suture; aperture obauriform; columellar fold white, compressed, subbasal, strong, almost transverse; lip scarcely thickened. Length 8.0, diam. 4.0 mm." (*Pse.*)

Kauai (Pease): Kaholuamano, and at 4000 ft. (Perkins).

L. brevicula PSE., Journ. de Conchyl., xvii, 1869, p. 169.—SYKES, Fauna Haw., ii, p. 358.—*Achatinella* (*Leptachatina*) *brevicula* PFR., Mon. Hel. Viv., viii, p. 246.

An example, sent by Pease to the Acad. N. S. Phila., has the following measurements: Length 7.3, diam. 3.9, length of aperture 3.5 mm., with 6¼ whorls. The species is closely related to *L. gummea* Gul. from Oahu.

29*a*. *L. b. micra* n. var. Pl. 8, fig. 55.

The shell is much smaller and proportionally, and more obese than typical specimens of *L. brevicula*. Length 6.1, diam. 3.1, length of aperture 2.8 mm.

Kauai: Haleieie at 1700 ft. and Milolii at 1500 ft. (Cooke).

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30. L. ACCINCTA (Mighels). Pl. 3, figs. 53, 56.

"Shell dextral, conical, horn color, smooth, polished, imperforate; whorls six, convex, with an impressed revolving line just below the suture; aperture semiovate; lip simple acute. Length 4/15, diam. 2/15 inch." (6.6 x 3.3 mm.) (*Mighels.*)

Oahu (Mighels): Keawaawa (Gulick); Waianae Mts., back of Waialua (Lyman); Waianae Mts., Leilehua (Cooke).

Achatina accincta MIGHELS, Proc. Bost. Soc. N. H., ii, 1845, p. 20.—REEVE, Conch. Icon., Achatina, sp. 101.—PFR., Mon. Hel. Viv., ii, p. 271; iii, p. 504.—*Achatinella* (*Amastra*) *accincta* PFR., Mon. Hel. Viv., iv, p. 545; vi, p. 177; viii, p. 235. —*Achatinella* (*Leptachatina*) *margarita* PFR., P. Z. S. London, 1855, p. 206; Mon. Hel. Viv., iv, p. 568; vi, p. 187; viii, p. 247.—*Achatinella granifera* GUL., Ann. Lyc. N. Y., vi, 1856, p. 185, pl. 6, fig. 13.—*Leptachatina granifera* = *margarita* GUL., P. Z. S. London, 1873, p. 91.—*Leptachatina granifera* SYKES, Proc. Malac. Soc. London, iii, pl. 14, fig. 5.—*Leptachatina accincta* PSE., P. Z. S. London, 1869, p. 650.—SYKES, Fauna Haw., ii, 1900, p. 356. Not *Achatinella accincta* GLD., U. S. Expl. Exped. Moll., pl. 7, fig. 97 = *L. ventulus* Fér.

The shells referred to this species are sometimes minutely perforate, very glossy, and under a lens faintly striate. The spire is ovately conical, apex subobtuse. The suture is slightly impressed, narrowly margined. The whorls are very slightly convex. The aperture is slightly oblique and very slightly diagonal. Columellar fold rather strong. Lip thickened, whitish.

Length 7.2, diam. 3.5, length of ap. 3.2 mm. (Leilehua).

Length 5.5, diam. 2.8, length of ap. 2.6 mm. (Leilehua).

Length 6.0, diam. 3.2, length of ap. 2.7 mm. (Waianae Mts., back of Waialua).

The last shell has a much smaller columellar fold than the other two.

Pfeiffer's measurements for *margarita* are: Length 6.3, diam. 3.0 mm. Aperture 3.0 x 1⅔ mm.

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Gulick's, for *granifera* are: Length 7.0, diam. 3.3 mm.; length of body whorl 4.5 mm.

I have followed Mr. Sykes in referring Pfeiffer's and Gulick's species to *accincta*. Unfortunately Mighels's type is probably lost as no trace of it could be found. The figure in the U. S. Exp. Exped., Moll., pl. 7, fig. 97, belongs to an entirely different species, *L. ventulus* Fér.

31. L. CRYSTALLINA (Gulick). Pl. 3; fig. 50.

"Shell dextral, imperforate, oblong, thin, shining, transparent, vitreous, microscopically very finely striated; apex somewhat obtuse; spire convexly conical; suture simple, moderately impressed; whorls 6, somewhat convex; columellar fold central, corneous, but slightly developed; aperture rotundately lunate; peristome simple, bordered with white; with dextral margin unreflected, arcuate; columellar margin dilated. Length 6.0, diam. 3.0, length of body whorl 4.0 mm." (*Gulick.*)

Oahu: Mokuleia, under stones in open country. (Gulick.)

" Var. b. With a brown spiral line accompanying the suture." (*Gulick.*)

"Var. c. Larger, not so transparent." (*Gulick.*)

Oahu: Kamoo, Waialua. (Gulick.)

Achatinella crystallina GULICK, Ann. Lyc. N. Y., vi, 1856, p. 186, pl. 6, fig. 14.—*Achatinella nitida* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 327.—PFR., Mon. Hel. Viv., vi, 184.—*Leptachatina crystallina* SYKES, Fauna Haw., ii, 1900, p. 361.

A small ovate species related to the shells referred to *L. accincta* Mighels, but more slender, with a less conical spire, and with a more perpendicular and narrower aperture. A specimen in the collection of the Academy of Natural Science of Philadelphia, no. 91807, has the following measurements: length 6.6, diam. 2.9, length of apert. 2.8 mm.

32. L. GUMMEA (Gulick). Pl. 3, fig. 54.

"Shell dextral, imperforate, broad, oblong conic, thin, shining, pellucid, amber colored, very finely striated; apex rather obtuse; spire convexly conical; suture simple, lightly im-

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pressed; whorls 6, rather convex; columellar fold central, pale corneous, scarcely lamelliform; aperture sub-pyriform; peristome margined with white and thickened within; with dextral margin arcuate, very slightly reflected anteriorly; columellar margin dilated, adnate; parietal margin thin. Length 7.6, diam. 4.3, length of body whorl 5.3 mm." (*Gulick.*)

Oahu: Mokuleia, Lihue, (Gulick); Olomana (Gulick on label, Mus. Bost. Soc.); Punaluu, Hauula, Helemanu, Kailua, Waimanalo (Gulick, for *A. fragilis*); Palolo, Round Top, Mt. Tantalus, Pauoa, Nuuanu (Cooke).

Achatinella gummea GULICK, Ann. Lyc. N. Y., vi, 1856, p. 182, pl. 6, fig. 10.—*Achatinella fragilis* GULICK, Ann. Lyc. N. Y., vi, 1856, p. 182, pl. 6, fig. 11.—*Achatinella guttula* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 315.—*Achatinella* (*Leptachatina*) *gummea* PFEIFFER, Mon. Hel. Viv., iv, p. 566; vi, p. 184; viii, p. 247.—*Leptachatina gummea* SYKES, P. Malac. Soc. London, iii, pl. xiv, fig. 1.—*Leptachatina fragilis* SYKES, P. Malac. Soc. London, iii, pl. xiv, fig. 2.—*Leptachatina guttula* SYKES, Fauna Haw., ii, 1900, p. 363.

This is the commonest and most widespread species of *Leptachatina* on the Island of Oahu. It is nearly always present in the more or less open woods near forests, though it sometimes occurs in the damper and darker regions but not so abundantly.

I think that Newcomb, in his identification of *L. guttula* Gld., must have been mistaken, for typical shells of this species are entirely different from *gummea*. Gould's species is heavier, thicker, with a more ovate spire, the last whorl is more tumid and tapers more at the base, the lip is much more thickened and the columellar fold is smaller and more deeply seated than in *L. gummea*.

The species differs considerably in size as can be seen by the following measurements:

Length 7.8, diam. 4.0, length of apert. 3.6 mm. Nuuanu.
Length 9.8, diam. 4.9, length of apert. 4.8 mm. Nuuanu.
Length 6.8, diam. 3.8, length of apert. 3.6 mm. Round Top.
Length 8.5, diam. 4.5, length of apert. 4.2 mm. Palolo.
Length 7.6, diam. 4.0, length of body whorl 5.3 mm. (Gulick for *A. fragilis.*)

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33. L. ORYZA (Pfeiffer). Pl. 3, fig. 59.

"Shell subrimate, fusiform, somewhat striate, corneous (?); spire convexly conical, apex somewhat obtuse; suture light, simple; whorls 7, scarcely convex, the last nearly equal to 2/5 of the length, attenuate at the base; aperture scarcely oblique, acuminately oval; columellar fold subcompressed, acute; lip simple, erect, columellar margin subreflexed, adnate. Length 8.0, diam. 3.75, length of apert. 3.6, diam. 2 mm." (*Pfeiffer.*)

Oahu, subfossil (Frick, Newcomb): Keawaawa (Gulick).

Achatinella (*Leptachatina*) *oryza* PFEIFFER, P. Z. S. London, 1855, Feb., 1856, p. 206.—*Achatinella tritacea* GULICK, Ann. Lyc. N. Y., vi, Dec., 1856, p. 184, pl. 6, fig. 12.—*Achatinella oryza* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 322.—*Achatinella* (*Leptachatina*) *oryza* PFEIFFER, Mon. Hel. Viv., iv, p. 567; vi, p. 185; viii, p. 247.—*Leptachatina oryza* PEASE, P. Z. S. London, 1869, p. 651.—*Leptachatina tritacea* SYKES, P. Malac. Soc. London, iii, 1899, pl. 14, fig. 8.—*Leptachatina oryza* SYKES, Fauna Haw., ii, 1900, p. 367.

I follow Newcomb and Sykes in placing Gulick's species *tritacea* with the one above. The main difference between Gulick's and Pfeiffer's specimens is that the former is always imperforate while that of Pfeiffer is distinctly rimate. A specimen of *tritacea* from Gulick's collection is figured, pl. 3, fig. 52.

33*a*. *L. o. subcylindracea* n. var. Pl. 3, figs. 60, 61.

The shell is smaller than typical specimens of *oryza*, more cylindrical; the suture is broadly margined; whorls 6¾; aperture nearly vertical, slightly contracted. Length 6.6, diam. 2.7, length of apert. 2.6 mm.

Oahu, fossil (Newcomb). Type no. 57820 A. N. S. P.

34. L. VANA Sykes. Pl. 3, fig. 57.

"Shell pyramidately conic, dextral, imperforate, somewhat thin, brownish corneous, glossy, under a lens obsoletely longitudinally striate, suture marginate; whorls 8, slowly increasing, the last whorl equal to 5/8 the length of the shell; aper-

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ture pyriform, dextral margin acute, columellar margin subreflexed, sinuate, furnished with a small fold, with the margins united by a very thin callus. Length 7.8, diam. 3.9 mm." (*Sykes.*)

Oahu: Mt. Kaala (Perkins).

Leptachatina vana SYKES, Fauna Hawaiiensis, ii, Moll., 1900, p. 372, pl. xi, fig. 27.

"A brownish horny, pyramidal shell which has no striking characters." (*Sykes.*) Mr. Sykes' figure is copied.

35. L. CAPTIOSA n. sp. Pl. 11, fig. 12.

The shell is minutely perforate, ovate, corneous, nearly solid, hardly diaphanous, scarcely glossy, under a lens faintly and closely striated with lines of growth. Spire nearly conic, with slightly convex outlines; apex rounded. Suture simple, scarcely impressed. Whorls 6¼, the first 3 closely coiled, nearly flat, the rest increasing more rapidly, very slightly convex, the last large, nearly cylindrical, tapering very gradually towards the base. Aperture rather large, subovate, very slightly oblique, nearly perpendicular. Columella nearly straight, arcuate below, with an acute callus along its face; columellar fold rather strong, nearly basal, oblique, extending to the outer margin. Outer lip slightly arcuate, distinctly thickened; columellar margin thin, adnate above; both margins united by a thin, transparent callus with its outer edge slightly thickened. Umbilicus very minute. Length 10.0, diam. 5.0. Length of ap. 4.8 mm.

Oahu: Waianae Mts., back of Leilehua (Cooke).

Somewhat related to *L. pulchra* but with fewer whorls. *L. captiosa* is broader in proportion to its length. This species is also related to *L. fuscula* Gul. The spire is however, more convex, and the surface is smoother.

36. L. PULCHRA n. sp. Pl. 10, figs. 7, 8.

The shell is imperforate, (sometimes minutely perforate), elongate-ovate, spire and upper part of last whorl light brown, base darker brown, with a dark brown band accompanying the sutures, somewhat glossy, under a lens striate

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with lines of growth. Spire nearly conic with slightly convex outlines, apex slightly acute. Suture hardly impressed, faintly margined, slightly crenulate. Whorls 6¾, almost flat, increasing regularly, the last nearly cylindrical, tapering towards the base, ascending slightly near the lip. Aperture very slightly oblique, slightly diagonal, subovate, somewhat angled at its juncture with the columella. Columella nearly straight, with an acute callus along its face; columellar fold rather strong, oblique, subbasal. Outer lip regularly curved, distinctly thickened within, columellar margin thickened, usually appressed and adnate. Umbilicus, when present, minute. Length 8.3, diam. 3.9; length of ap. 3.6 mm.

Oahu: Waianae Mts. back of Leilehua (Cooke).

A beautiful distinct species found in open country at the base of small ferns. Related to *L. vana* Sykes, but narrower in proportion to its length and with a less conic spire. There is a larger and lighter-colored variety of this shell of which I have only three specimens. Of this variety a well developed specimen measures, length 9.8, diam. 4.1 mm.

37. L. OPIPARA n. sp. Pl. 12, fig. 1.

The shell is imperforate, narrowly ovate, corneous, thin, glossy, subdiaphanous, the embryonic whorls smooth, the rest, under a lens, closely and distinctly striate, with numerous very close, and very fine spiral striae. Spire narrowly ovate, apex rounded. Suture faintly margined, crenulate, scarcely impressed, Whorls 6¼, slightly convex, the neanic increasing slowly and regularly, the last increasing more rapidly, nearly cylindrical, tapering towards the base. Aperture large, subpyriform, slightly oblique and very slightly diagonal. Columella nearly straight, its face slightly concave, with a rather strong flattened lamella. Outer margin of lip erect, thickened within, nearly flat above, regularly curved below, columellar margin slightly thickened, appressed, adnate. Length 9.4, diam. 4.3; length of ap. 4.2 mm.

Oahu: Apex of mountain range back of Palolo Valley (Cooke).

L. opipara is most closely related to *L. gummea* Gulick. It

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is much narrower in proportion to its length with more convex outlines and slightly more distinctly striate. As far as I know, this species has only been collected once and that in the locality mentioned above when 5 closely agreeing specimens were taken.

38. L. EMERITA Sykes. Pl. 6, figs. 1, 2, 3.

"The shell is elongate, subcylindrical, imperforate, dextral, corneous, or hyaline or yellow, somewhat thin, under a lens longitudinally striate, apex somewhat obtuse; whorls 6½, flatly convex, the last almost equal to ⅝ the length of the shell; suture impressed, marginate; aperture ovate, with the dextral margin slightly thickened, columellar margin subreflexed, furnished with a small inconspicuous ascending lamella. Length 8.0, diam. 3.5 mm." (*Sykes.*)

Molokai: Kalamaula, and at 4000 ft. (Perkins); Kaunakakai, under stones (McGregor); Kamoku Hill, Ulapue, Halawa (Thaanum); near Waikolu (Cooke).

Leptachatina emerita SYKES, Fauna Hawaiiensis, ii, 1900, p. 361, pl. xi, fig. 10.

"Variable in color, shading from brown to a hyaline tint; adult specimens lose their gloss and become of a straw-yellow. The columellar plait is small and inconspicuous." (*Sykes.*)

The penultimate whorl is often tumid. Large specimens of this species, with 7 whorls, have the following measurements: length 8.5, diam. 3.6, length of ap. 3.6 mm. There is a smaller variety of this species, having the same color variations. A specimen with 6½ whorls measured length 6.9, diam. 3.1, length of ap. 3.0 mm. Fig. 3 is a copy of Mr. Sykes' original figure.

39. L. CONCOLOR n. sp. Pl. 6, figs. 9, 10.

The shell is imperforate, elongately ovate, yellowish corneous or straw-color, dull, rather thin, hardly diaphanous, under a lens the first two whorls are smooth, the third and fourth very closely striate, the last three a little more coarsely striate, especially at the sutures. Spire acutely conically ovate, apex obtuse. Suture simple, hardly impressed, crenu-

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late. Whorls 7, slightly convex, the last elongate, tapering at the base. Aperture slightly oblique, perpendicular, narrowly ovate. Columella twisted, nearly straight, with a rather small oblique lamella. Outer lip very slightly arcuate, slightly thickened within, columellar margin thin, reflexed, adnate. Length 8.6, diam. 3.5, length of ap. 3.4 mm.

Molokai: Kamalo (Thaanum).

In texture and color this species approaches *L. emerita* Sykes. The form of the shell is different and the aperture is narrower, with a stronger columellar fold. In form it is somewhat related to *L. lævigata* Cooke but differs in proportion of length to breadth, texture of its surface, etc.

40. L. CONICOIDES Sykes. Pl. 6, figs. 11, 14, 15.

"The shell is conically ovate, imperforate, dextral, somewhat thin, corneous, crenulate at the sutures; whorls 6, the last equal to 4/7 the length of the shell; suture subimpressed; aperture subvertical, sinuately oblong, with the dextral margin slightly thickened, columellar margin reflexed, adnate, furnished with a small, compressed, oblique fold, the margins united by a thin callus. Length 7.5, diam. 3.5 mm." (*Sykes.*)

Molokai (Perkins): near Waikolu (Cooke).

Leptachatina conicoides SYKES, Fauna Haw., ii, 1900, p. 359, pl. xi, fig. 26.

"A somewhat conic shell, in which, when adult, the columellar plait becomes inconspicuous." (*Sykes.*) Fig. 11 is a copy of the original figure.

Lept. emerita is somewhat related to this species, it is usually larger, the suture is not crenulate and the spire is convex in outlines. A single specimen of this species from near Waikolu measures as follows: length 7.5, diam. 3.5, length of aperture 3.4 mm.

41. L. VARIA n. sp. Pl. 11, fig. 1.

The shell is imperforate, ovately conic, dark brown, with a narrow indistinct whitish band accompanying the suture, somewhat solid, glossy, nearly smooth, under a lens minutely striate

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with lines of growth. Spire conic, apex somewhat acute. Suture simple, hardly impressed. Whorls 6, nearly flat, the last two increasing rather rapidly, the last subcylindrical, tapering towards the base. Aperture subovate, brownish within, slightly oblique, hardly diagonal. Columella straight, heavily calloused, with a thick white callus along its face; columellar fold small, oblique, deeply situated. Outer lip regularly curved, strongly calloused within and with a broad yellowish white margin without; columellar margin thickened, white, appressed, adnate; both margins united by a rather thick, transparent or whitish callus. Length 8.5, diam. 4.1, length of ap. 3.9 mm.

Molokai: Pali-ko-i in Halawa and fossil at the mouth of Halawa Valley (Thaanum).

I know of no species closely related to *L. varia*. *L. coruscans* Hartman is probably its closest relative on Molokai, but the shell is larger, broader in proportion to its length and thinner. The most distinctive character is the strongly thickened margin of the outer lip. This character is also very prominent in *L. guttula* Gould of Maui.

There is a lighter colored, yellowish corneous variety. The fossil shells, from the mouth of Halawa, are slightly larger than typical specimens of this species, measuring 9.4 x 4.2 mm. A few specimens have a duplicate outer lip.

42. L. OVATA n. sp. Pl. 2, fig. 30.

The shell is imperforate, ovate, the embryonic whorls greenish corneous, the rest brownish corneous, with a narrow reddish band accompanying the suture, very glossy, very thin, diaphanous, under a lens very minutely striate with lines of growth. Spire ovate, apex obtuse. Suture slightly impressed, faintly margined, minutely crenulate. Whorls nearly 6, slightly convex, the last two slightly swollen, the last large, tapering to the base. Aperture large, about one-half the length of the shell, ovate, slightly oblique, perpendicular. Columella slightly oblique, twisted, with a rather strong oblique fold. Outer lip slightly thickened, a little darker than the rest of the shell; columellar margin thin, adnate, length 7.0, diam. 3.6, length of ap. 3.3 mm.

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West Maui: Maunahoomaha (Thaanum, Cooke), Honokahau Gulch, Honokowai Gulch, Iao Valley (Thaanum), Kauaula, Honolua (Baldwin).

A rather abundant species on West Maui. Two lots of shells in Mr. Baldwin's collection from Makawao and Ulapalakua, East Maui, are provisionally located in this species.

L. ovata is most closely related to *L. vitreola* Gul. It differs in its smaller size, shorter and more ovate spire, larger aperture, and being proportionally broader. In some specimens the sutural band is lacking.

✓ 43. L. GRANA (Newcomb). Pl. 2, figs. 26, 27.

"Shell dextral, ovate-conic, solid, corneous; whorls 6, faintly margined; aperture ovate; columella with a strong plaited tooth; outer lip slightly thickened, white; columellar lip expanded and applied to the body whorl. Length 0.3, breadth 0.1 inch" (7.5 x 2.5 mm). (*Newc.*)

East Maui: Makawao (Newcomb); Haleakala, at 5000 feet (Perkins).

Achatinella grana NEWCOMB, Ann. Lyc. New York, vi, 1853, p. 29; Proc. Zool. Soc. London, 1853 (1854), p. 146 (not pl. 23, fig. 46, = *L. ovata*).—*Achatinella* (*Leptachatina*) *grana* PFR., Mon. Hel. Viv., iv, p. 567.—*Leptachatina grana* PEASE, P. Z. S., 1869, p. 651.—SYKES, Fauna Haw., ii, 1900, p. 363.

Newcomb's description in the P. Z. S. differs slightly from the original one given above. He gives the form as "elongately conic" and the length as 0.25 inch (6.2 mm.). The figure accompanying the description does not agree with the measurements given in either of his two descriptions. In the figure the breadth is a little more than one-half of the length, while in the original description it is just one-third.

In the collection of the Academy of Natural Sciences of Phila. (no. 57810) is a tray of shells labeled *grana*, presented by the author. This tray contained two distinct species. Some of the specimens (pl. 2, figs. 26, 27) agree closely with Newcomb's original description, having the following measurements: length 6.1, diam. 2.7, length of ap. 2.7 mm.; the

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columellar fold is not very strong and is very oblique. The other shells in the same tray agree with typical specimens of *L. ovata* from West Maui; and these last agree with Newcomb's figure.

44. L. VITREOLA (Gulick). Pl. 2, figs. 28, 29.

"Shell dextral, imperforate, elongately ovate, thin, shining, pellucid, vitreous, microscopically finely striated; apex rather obtuse; spire convexly conic; suture simple, moderately impressed; whorls nearly 7, somewhat convex; columella lightly plaited deep within the aperture; aperture pyriform; peristome simple; with dextral margin unreflected, arcuate; columellar margin narrow, adnate; parietal margin wanting. Length 8.0, diam. 3.5 mm.; body whorl 4.5 mm. long" (*Gul.*).

West Maui (Baldwin): Maunahoomaha (Thaanum, Cooke); Honokohau Gulch, Honokowai Gulch, Akau-ka-imu (Thaanum).

Achatinella vitreola GUL., Ann. Lyc. N. Y., vi, 1856, p. 194, pl. 6, fig. 23.—*Achatinella parvula* GUL., Ann. Lyc. N. Y., vi, 1856, p. 195, pl. 6, fig. 24.—*Achatinella grana* NEWC., Ann. Lyc. N. Y., vi, 1858, p. 330; Proc. Zool. Soc. London, 1853, p. 146, pl. 33, fig. 46.—*Leptachatina parvula* SYKES, Proc. Mal. Soc. London, iii, pl. 14, fig. 13.—*Leptachatina vitreola* SYKES, Fauna Haw., ii, 1900, p. 372.

A single shell collected in West Maui agrees closely with the type in the collection of the Boston Society, except that it is slightly broader, measuring, length 8.0, diam. 3.8, length of ap. 3.4 mm.

I cannot follow Newcomb in considering this species equal to *L. grana* Newc. The two species are entirely distinct.

Figs. 28, 29 represent a cotype in coll. A. N. S. P.; the figure below fig. 28 is a copy of Mr. Sykes's figure of the type of *L. parvula*, see below.

I follow Mr. Sykes in including *L. parvula* with this species. It differs somewhat from the typical forms of *L. vitreola*, being considerably smaller and broader in proportion to its length. It might properly to considered a variety.

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44*a*. *L. vitreola parvula* Gulick. Pl. 2, fig. below 28.

"Shell dextral, imperforate, conic-oblong, thin, shining, pellucid, glossy, of amber hue, microscopically very finely striated; apex obtuse; spire convexly conical; suture simple, moderately impressed; whorls 6, rather convex; columella with a light internal plait; aperture pyriform; peristome simple, unreflected; with columellar margin narrow, adnate; parietal margin wanting. Length 6⅓, diam. 4 mm.; average weight 0.1 grain. Nearly of the size and color of *A. granifera*, but of a more cylindrically oblong shape, with a narrower base" (*Gulick*).

The type locality was unknown. Mr. Sykes has figured the type, his figure being copied on my plate, between figs. 27 and 35.

45. L. GUTTULA (Gould). Pl. 2, figs. 34, 35, 36.

"Shell small, thin, translucid, shining, short ovate, yellowish-green, slightly striated lengthwise, with sometimes a faint appearance of revolving bands. Whorls 6, short, slightly convex, the last tumid, more than half the length of the shell. Aperture small, lunate; lip white, thickened, strongly truncate at the base; columella short, furnished with a small fold, the penultimate whorl covered with a callus. Length ⅛, diam. 3/16 inch." (*Gould.*)

Maui (Gld.): East Maui (Baldwin).

Achatinella guttula GOULD, Proc. Bost. Soc., ii, 1845, p. 201; U. S. Exp. Exp., Moll., p. 89, pl. 7, figs. 98, 99*a*.—NEWC., Ann. Lyc. N. Y., vi, 1858, p. 315.—PFR., Mon. Hel. Viv., iii, p. 467.—*Achatinella* (*Leptachatina*) *guttula* PFR., Mon. Hel. Viv., iv, p. 567; vi, p. 185; viii, p. 247.—*Leptachatina guttula* PEASE, Proc. Zool. Soc. London, 1869, p. 651.—SYKES, Fauna Haw., ii, 1900, p. 363.

"One of the smallest, and proportionally the shortest of the group, its length being but little greater than its breadth. It is much more ventricose and less solid than *A. accincta* Migh." (*Gld.*)

The measurements in both of Gould's descriptions are probably wrong. In both of these he says, in his notes, that

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the length is but "little greater than its breadth." The type specimen in the National Museum, Washington, and his figures, show that "⅛" is probably a misprint for ⅓. His figure, natural size, is 8.0 mm. long and 4.3 broad.

I cannot follow Newcomb in considering *L. gummea* Gul., identical with this species. A specimen of *guttula* carefully compared with the type (and agreeing closely) has more or less the characters of a Kauaian shell. There is an acute thick callus along the face of the columella. The lip is strongly thickened and there is quite a thick callus on the parietal wall. This specimen measures: Length 7.5, diam. 4.1, length of ap. 3.7 mm. This is quite close to the corrected Gould's measurements—8.3 x 4.7 mm.

Gould's figure of the type of *L. guttula* is copied, pl. 2, fig. 34.

46. L. SUBOVATA n. sp. Pl. 11, fig. 2.

The shell is imperforate, elongately ovate, brownish, thin diaphanous, glossy, under a lens minutely striate with lines of growth. Spire narrowly conic, with slightly convex outlines, apex somewhat obtuse. Suture scarcely impressed, margined with a rather indistinct narrow line. Whorls 6, increasing rather rapidly, very slightly convex, the last elongate, cylindrical, tapering gradually to the base. Aperture subovate, very slightly oblique and slightly diagonal. Columella slightly twisted, brownish corneous, with a very thin acute callus along its face; columellar fold basal, rather strong, oblique. Outer lip regularly curved, thickened within, white; columellar margin appressed, adnate. Length 7.3, diam. 3.4, length of ap. 3.3 mm.

Lanai (Thaanum).

A rather abundant species approaching *L. ovata* from West Maui. The latter is, however, slightly lighter colored and thinner, more pellucid, glossier and broader in proportion to its length. In *L. subovata* the penultimate whorl is slightly more convex. A few specimens have a narrow dark brown band at the suture.

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47. L. ARBOREA Sykes. Pl. 1, figs. 5, 6, 7.

"Shell ovately oblong; turrited, thin or somewhat thin, dextral, corneous, very lightly longitudinally striate; whorls 6-7, flatly convex, the last equal to 5/8 of the length of the shell; suture well impressed; aperture quadrately ovate, with the dextral margin slightly thickened, with the columellar margin vertical, thickened, reflexed, furnished with a small scarcely conspicuous fold. Length 8.0, diam. 3.6 mm." (*Sykes.*)

Hawaii: Kona at 4000 feet (Perkins); Olaa (Baldwin, Thaanu); Hamakua, subfossil (Ancey); Kaiwiki (Thaanum).

Leptachatina arborea SYKES, Fauna Haw., ii, 1900, p. 357, pl. xi, fig. 21.—ANCEY, Journ. of Malac. xi, 1904, p. 69.

The plica is very inconspicous; the color becomes lighter in adult specimens, and then the polished, transparent gloss disappears and the shell becomes of a straw color. Over thirty specimens were collected by Mr. Perkins; they vary slightly in shape, a few being broader in proportion to the length, and having more inflated whorls. Mr. Baldwin sends me the following note: "It is found on the candle-nut tree (*Aleurites moluccana*), among the leaves of the bird-nest fern (*Asplenium nidus*), sometimes at the height of 30 or 40 feet. All other known species of *Leptachatina* are terrestrial, living under rocks or on dead leaves and decaying wood."

48. L. SIMPLEX Pease. Pl. 1, figs. 8, 9.

"Shell dextral, somewhat thin, shining, imperforate, abbreviately or elongately ovate, longitudinally lightly striate, sometimes narrowly margined at the suture, corneous; whorls 6, flatly convex; aperture vertical, ovate; columellar fold white, basal, oblique, twisted; lip thickened. Length 8.0, diam. 3-4 mm." (*Pease.*)

Hawaii: Kona at 3000-4000 feet (Perkins); Waimea (Thaanum, Lyons, Baldwin, Henshaw and Lyman).

Leptachatina simplex PEASE, Journ. de Conchyl. 1869, p. 170.—*Achatinella* (*Leptachatina*) *simplex* PFR., Mon. Hel. Viv., viii, p. 247.—*Leptachatina simplex* HARTMAN, Proc. A.

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N. S. Phil., 1888, p. 55.—SYKES, Fauna Haw., ii, 1900, p. 369. —ANCEY, Journ. of Malac. xi, 1904, p. 69.

Two specimens, presented by Pease to the Philadelphia Academy, have the following measurements: 7.5 x 3.4 and 6.7 x 3.0 mm.

The species belongs to the same type of shell as *L. vitreola* Gul., *L. conicoides* Sykes, etc. It is characterized by its elongate spire, which has slightly convex outlines, and rather small perpendicular aperture. The species does not seem to be found in the fossil material from Mana. A specimen received from Pease is figured.

49. L. ANCEYANA n. sp. Pl. 1, figs. 18, 19.

The shell is minutely perforate, narrowly ovately conic, whitish (in fossil state), thin, under a lens minutely striate with lines of growth, the embryonic whorls smooth, glossy. Spire ovately conic, apex subobtuse. Suture simple, hardly impressed. Whorls 5½, slightly convex, the last elongate, subcylindrical, tapering to the base. Aperture oblique, nearly perpendicular, subovate, acute at both ends. Columella nearly straight, with a minute, oblique fold. Outer lip slightly arcuate, thickened within, columellar margin reflexed, subadnate, thin, with an acute longitudinal callus along its face. Umbilicus minute, subcircular. Length 5.4, diam. 2.5, length of aperture 2.5 mm.

Hawaii: Mana, fossil (Henshaw).

A small species unlike anything from Hawaii. Somewhat like *L. ovata* from Maui, but smaller and narrower in proportion to its length. The surface is minutely and very closely striate with lines of growth. This species is rather abundant in the fossil deposits explored by Dr. Henshaw in Mana.

50. L. DEFUNCTA n. sp. Pl. 1, fig. 16.

The shell is imperforate (sometimes minutely perforate), acuminately conic, whitish (in fossil state), embryonic whorls smooth, glossy, the rest dull, under a lens minutely striate with lines of growth. Spire elongately conic, apex obtuse.

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Suture slightly impressed, faintly and narrowly margined. Whorls 7, the third and fourth nearly flat, the rest slightly convex, the last elongate, tapering to the base. Aperture subovate, slightly oblique, nearly perpendicular. Columella nearly straight, with a rather strong oblique fold. Outer lip regularly arcuate, thickened within, columellar margin thickened, reflexed adnate. Length 9.0, diam. 3.8, length of ap. 3.5 mm.

Hawaii: Mana, fossil (Henshaw).

A rather variable species in size; one measures, length 10.4, diam. 4.8, length of ap. 4.3 mm. The aperture is small and very broad in proportion to its length.

51. L. LEPIDA n. sp. Pl. 1, figs. 12, 13.

The shell is imperforate (rarely perforate), ovately conical, brownish corneous, thin, subdiaphanous, glossy, under a lens minutely striate with lines of growth. Spire conic, apex blunt. Suture simple, scarcely impressed. Whorls 6, nearly flat, the last slightly rotundate, tapering to the base. Aperture subovate, rather broad, oblique, very slightly diagonal. Columella subtruncate, with a rather strong, oblique fold. Outer lip moderately arcuate, thickened within, white; columellar margin thickened, reflexed, adnate. Length 6.5, diam. 3.3, length of ap. 2.9 mm.

Hawaii: Mana (Thaanum).

From *L. simplex* this species differs in being smaller, with the same number of whorls, thicker, the whorls are flatter and the spire is shorter and more conic in outline.

G. *Group of L. nitida.*

52. L.(FUMIDA) (Gulick). Pl. 3, fig. 58.

"Shell dextral, imperforate, ovate conic, thin, shining, pellucid, corneous, with a dark line accompanying the suture, microscopically very finely striated; apex somewhat obtuse, pallid; spire convexly conical; suture simple, scarcely impressed; whorls 7, rather flat; columellar fold central, white, lamelliform; aperture pyriform; peristome simple; with dex-

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tral margin unreflected, semicircular; columellar margin dilated, white, adnate; parietal margin very thin, white. Length 8.0, diam. 4.3, length of body whorl 5.3 mm." (*Gulick.*)

Oahu: Waialei, Pupukea, Waimea, Kawailoa, Helemanu (Gulick); Waialua (Lyman); Waianae Mts., back of Leilehua (Cooke).

Achatinella fumida GULICK, Ann. Lyc. N. Y., vi, 1856, p. 181, pl. 6, fig. 9.—*Achatinella vitrea* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 328.—*Achatinella* (*Leptachatina*) *vitrea* PFR., Mon. Hel. Viv., vi, p. 183.—*Achatinella* (*Leptachatina*) *nitida ?* PFR., Mon. Hel. Viv., vi, p. 184. — *Leptachatina fumida* SYKES, P. Malac. Soc. London, iii, pl. 14, fig. 15; Fauna Haw., ii, 1900, p. 362.

L. fumida is somewhat closely related to *L. gummea* Gulick. It differs in its slightly more convex spire and its aperture is more perpendicular. It has no relationship with *L. cingula* Migh. (*L. vitrea* Newc.).

The measurements of two specimens are:

Length 8.0, diam. 4.2, length of apert. 3.7 mm. P. A. N. S. 91876.

Length 7.3, diam. 3.8, length of apert. 3.3 mm. Wailua.

53. L. CORUSCANS Hartman. Pl. 6, figs. 6, 7.

"Shell dextral, ovate, very thin and polished, spire one-third the length; apex obtuse, whorls 4½, rounded, the last one and a half inflated; suture impressed, aperture semi-ovate, with a very thin white lamellar tooth near the base; labium slightly thickened within and white, color amber. Length 9.0, diam. 4.5, length of ap. 3.5, diam. 2.5 mm." (*Hartman.*)

Molokai: Kamalo (Baldwin); Kapanui, Kolamaula, and at 4000 ft. (Perkins); Mapulehu Ridge (Thaanum).

Leptachatina coruscans HARTMAN, Proc. Acad. Nat. Sci. Phila., 1888, p. 52, pl. 1, fig. 16.—SYKES, Fauna Haw., ii, Moll., p. 360.

Dr. Hartman must have miscounted the number of whorls in his type specimen, as a photograph of the type, in the col-

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lection of the Philadelphia Academy has from 5 to 6 whorls. I know of no species of *Leptachatina,* when adult, with as few as 4½ whorls. Adult specimens usually have from 5½ to 6½ whorls.

This species is very variable in thickness and color. Some of the specimens are dark brown with intergrades to light greenish corneous. It also varies from ovate to ovate turrited in form.

53*a*. *L. c. dissimilis* n. var. Pl. 6, fig. 8.

The shell is imperforate, broadly ovate, corneous, diaphanous, minutely and closely striate or costulate. Suture subimpressed, narrowly margined. Whorls 6½, nearly flat, the last very large. Aperture elongately ovate, narrow, slightly oblique, perpendicular. Columella truncate, with a rather strong fold. Lip slightly thickened. Length 7.6, diam. 4.1, length of ap. 4.0 mm.

Molokai: near Waikolu (Cooke).

This variety is smaller, more distinctly striate and thinner than the typical form of the species.

✓54. L. NITIDA (Newcomb). Pl. 2, figs. 20, 21.

"Shell dextral, ovately conical, thin, pellucid, shining, light corneous, with a faint linear band of red beneath the suture; whorls 6, ventricose; suture margined; aperture ovate; columella terminating in a twisted oblique white plait, lip thin. Length 0.4, diam. 0.11 inch." (10.0 x 2.7 mm.) (*Newc.*)

East Maui (Newc.): Kula and Ulapalakua (Baldwin). ? Oahu: Mt. Kaala (Perkins). ? Molokai (Borcherding).

Achatinella nitida NEWCOMB, Ann. Lyc. New York, vi, 1853, p. 29; Proc. Zool. Soc. London, 1853 (1854), p. 140, pl. 23, fig. 30.—*Achatinella* (*Leptachatina*) *nitida* PFR., Mon. Hel. Viv., iv, p. 566.—*Leptachatina nitida* PEASE, P. Z. S., 1869, p. 651.—SYKES, Fauna Haw., ii, 1900, p. 366.—? BORCHERDING, Zoologica, 48[II], p. 127, pl. 9, fig. 9-9a.

In the original description the diameter is given as 0.11 inch (2.7 mm.) this is only about half the actual diameter. In the description (Proc. Zool. Soc. 1853, p. 140) this was

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corrected to 4/20 inch (5.0 mm.). Specimens presented by Dr. Newcomb to the Philadelphia Academy have the following measurements:

Length 10.1, diam. 4.9, length of aperture 4.7 mm.

Length 9.9, diam. 4.7, length of aperture 4.5 mm.

Length 8.8, diam. 4.3, length of aperture 4.1 mm.

Under a lens the shells are minutely striate and in some of the specimens there is a faint spiral band at the periphery; the aperture is very slightly diagonal; one of the specimens is of a uniform reddish brown color. The shells collected by Mr. Perkins on Oahu are not typical and possibly belong to another species. They come pretty close to *L. capitosa*.

Borcherding's specimens from Molokai probably equal *Lept. coruscans* Hartm.

54*a*. *L. n. occidentalis* n. var. Pl. 2, fig. 22.

The shell is slightly broader in proportion to its length than *L. nitida*, thicker, darker colored, except the embryonic whorls, less shining. Whorls 6, the first 4 closely coiled and flat, the two last increasing rapidly, tumid. Aperture perpendicular. Columella nearly straight, with a rather strong almost transverse fold. Outer lip thickened, white; parietal margin with a rather thick polished callus. Length 10.0, diam. 5.1, length of ap. 5.0 mm.

West Maui. Maunanahoomaha (Thaanum, Cooke); Lahaina (Baldwin).

55. L. PRÆSTABILIS n. sp. Pl. 2, figs. 37, 38.

The shell is imperforate, elongately oval, corneous, with a narrow reddish line accompanying the suture, glossy, solid, distinctly striate, especially just below the suture. Spire elongate, with slightly convex outlines, apex obtuse. Suture slightly impressed, margined. Whorls nearly 7, slightly convex, regularly increasing, the last subcylindrical, tapering to the base. Aperture broadly ovate, oblique, slightly diagonal. Columella nearly straight, white, with a rather strong oblique fold extending to the margin. Outer lip strongly arcuate, slightly thickened within, whitish; colu-

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mellar margin reflexed, adnate. Length 9.9, diam. 5.2, length of ap. 4.0 mm.

West Maui: Lahaina (Baldwin).

This species is related to *L. nitida* Newc. It differs, however, in its longer, more slender and less ovate spire; the upper whorls are more attenuate; the apex more acute; and the aperture is more diagonal, shorter and broader in proportion to its length.

56. L. COMPACTA (Pease). Pl. 2, fig. 25.

"Shell dextral, somewhat solid, imperforate, subconic or acutely ovate, scarcely striate, brownish corneous; spire short, subobtuse; whorls 5, slightly convex, the last equal to one-half of the length; aperture elliptical, angulate at both ends; columellar fold small, callous, oblique, white; lip thickened, with margins united with a callus, columella adnate. Length 8.0, diam. 4.0 mm." (*Pse.*)

Maui (Pease): East Maui, Makawao (Baldwin); Haleakala, at 5000 feet (Perkins).

Labiella compacta PEASE, Journ. de Conchyl., xvii, 1869, p. 172.—*Labiella compacta* PFR., Mon. Hel. Viv., viii, p. 219.—*Leptachatina compacta* PSE., Proc. Zool. Soc. London, 1869, 651.—SYKES, Fauna Haw., ii, 1900, p. 359.

A shell before me, which I have referred to this species (pl. 2, fig. 25) has the following measurements; length 8.2, diam. 4.3, length of ap. 4.0 mm. It is slightly larger than the measurements given by Pease and has 1½ more whorls. The species, if my determination is correct, is about midway between *L. nitida* Newc., and *L. lenta.*

Unfortunately the type of the species is unfigured and I have been unable to find a single authentic specimen.

57. L. ISTHMICA Ancey. Pl. 2, fig. below fig. 30; pl. 12, figs. 9, 10.

"Shell subfossil (if not altogether extinct), quite thick for the genus, subopaque, shining, white, the last whorl generally pale red below the suture, lip white: oblong conoidal, smooth, under a strong lens furnished with minute lines of growth

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especially at the upper part of each whorl, imperforate or covered subrimate. Spire convexly attenuate, conoidal, apex minute, somewhat obtuse. Whorls 7, almost flat, regularly increasing, suture line-like, pellucidly marginate; the last oblong, regularly attenuate at the base. Aperture suboblique, oblong, angled above, contracted below, furnished with quite a strong columellar fold. Lip thickened, obtuse, at the columella above the place of the perforation slightly dilated with callus, with the margins united with a callus. Length 9.0, diam. 4.0, length of ap. 4.0 mm." (*Ancey.*)

Maui: sand hills between East and West Maui (Baldwin).

Leptachatina isthmica ANCEY, Proc. Malac. Soc. London, iii, 1899, p. 270.—SYKES, Proc. Malac. Soc. London, iii, 1899, pl. 13, fig. 20.

L. isthmica is more closely related to *L. compacta* Pse., than to any other species. Specimens referred to the latter species differ mainly in having a shorter spire and two whorls less. Mr. Sykes' figure of a type is copied on plate 2. A topotype is drawn on plate 12.

58. L. KONAENSIS Sykes. Pl. 1, figs. 1, 2, 3.

"Shell elongately ovate, imperforate, dextral, somewhat thin, corneous or pale corneous, finely longitudinally striate, apex slightly obtuse; whorls 6, flat, the last equal to 5/8 the length of the shell; suture impressed, marginate; aperture sinuately ovate, columella arcuate, dextral margin thickened within, columellar margin subreflexed, furnished with a small ascending fold. Length 8.0, diam. 4.0 mm." (Sykes).

Hawaii: Kona at 4000 feet (Perkins); Waimea (Baldwin, Lyons, Thaanum); Hamakua (Baldwin).

Leptachatina konaensis SYKES, Fauna Haw., ii, 1900, p. 364, pl. xi, fig. 13.

The shells from Waimea agree closely with the type in the British Museum. Fig. 3 is a copy of the original illustration.

58*a*. *L. k. olaaensis* n. var. Pl. 1, fig. 4.

The shell is larger, heavier, thicker, more coarsely striate than typical specimens, and of a dull dirty yellow color.

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Whorls 6⅓. Aperture large, about ½ the length of the shell, nearly perpendicular. Length 9.0, diam. 4.7, length of aperture 4.5 mm.

Hawaii: Olaa (Henshaw).

H. *Group of L. glutinosa.*

59. L. GLUTINOSA (Pfeiffer). Pl. 5, fig. 92.

"Shell imperforate, dextral, ovately conic, somewhat solid, slightly arcuately striate, under the glossy epidermis, yellowish white; spire almost regularly conic, apex somewhat obtuse; suture fine, crenulate; whorls 7, nearly flat, the last hardly shorter than the spire, rotundate at the base; aperture subvertical, sinuately semioval, white within; columellar fold compressed, twisted, almost transverse; lip erect, with the margins united by a callus, the right margin slightly thickened, the columellar margin callous, reflexed, adnate. Length 11.3, diam. 6.0 mm." (*Pfr.*)

Oahu: Lihue, Kalaikoa, Waihiawa, Helemanu, Peula (Gulick); Waianae Mts., below Kaala (Perkins, Cooke); Waianae Mts., at Palehua and back of Leilehua (Cooke).

Achatinella (*Laminella*) *glutinosa* PFEIFFER, P. Z. S. London, 1855, p. 204; Mon. Hel. Viv., iv, p. 557; vi, p. 181; viii, p. 243.—*Achatinella lacrima* GULICK, Ann. Lyc. N. Y., vi, 1856, p. 176, pl. 6, fig. 4.—*Leptachatina glutinosa* PEASE, P. Z. S. London, 1869, p. 651.—SYKES, Fauna Haw., ii, 1900, p. 363.

An examination of both Pfeiffer's and Gulick's types leads me to follow Newcomb and Sykes in considering Gulick's species as identical with *L. glutinosa*.

This is one of the largest species of *Leptachatina* from Oahu. Specimens from the Waianae Mts., back of Leilehua are smaller, more glossy and slightly darker colored than those from the other localities.

The measurements of a few specimens from some of the different localities are:

Length 10.5, diam. 6.0, length of apert. 5.5 mm. Halemano.

Length 10.8, diam. 5.6, length of apert. 5.2 mm. Leilehua.

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Length 11.7, diam. 6.3, length of apert. 6.1 mm. Palehua.

Length 12.5, diam. 6.3, length of apert. 6.0 mm. Lihue (Baldwin's coll.)

60. L. DIMIDIATA (Pfeiffer). Pl. 5, figs. 93, 94, 95, 96.

"Shell imperforate, ovately conic, somewhat solid, slightly striate, glossy, blackish chestnut above; spire convexly conic, apex somewhat obtuse; suture light, subcrenulate; whorls 6½, somewhat flat, the last a little shorter than the spire, from the middle to the base pale corneous; aperture scarcely oblique, sinuately oval, unicolorous within; columellar fold callous, suboblique; lip white, not expanded, thickened within; columellar margin narrow, adnate. Length 11.0, diam. 5.5 mm." (*Pfr.*)

"Var. *b*. With the last whorl unicolorous chestnut, spire paler." (*Pfr.*)

Oahu: Halemano, Kawailoa Gulch (Perkins); Waialei, Kawailoa, Kalaikoa (Gulick).

Achatinella (*Leptachatina*) *dimidiata* PFR., P. Z. S. London, 1855, p. 205.—Mon. Hel. Viv., iv, p. 564; vi, p. 184; viii, p. 246.—*Leptachatina dimidiata* PEASE, P. Z. S. London, 1869, p. 651.—*Leptachatina cingula* HARTMAN, Proc. A. N. S. Phila., 1888, p. 52, pl. 1, fig. 14.—SYKES, Fauna Haw., ii, 1900, p. 359.

I am quite sure that Pfeiffer's species cannot be referred to *L. cingula* Migh. *L. dimidiata* is shorter with a somewhat narrower aperture, and the color patterns are entirely different.

The most abundant color-variety is not mentioned by Pfeiffer. The shell is whitish-corneous, with a rather broad chestnut band just above the periphery and continued on the spire above the suture.

Two specimens have the following measurements:

Length 9.9, diam. 5.5, length of apert. 5.2 mm.

Length 11.2, diam. 5.8, length of apert. 5.5 mm.

61. L. PYRAMIS (Pfeiffer). Pl. 3, figs. 43, 44.

"Shell ovately pyramidal, very lightly striate, diaphanous,

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greenish corneous; spire pyramidal, apex acute; suture linear, narrowly margined; whorls 8, flat, the last nearly equal to 3/8 of the length; columella furnished with a very shortly arcuate, flattened, dentiform, acute fold; aperture oval. Length 12.0, diam 5.5 mm." (*Pfeiffer.*)

Oahu: Waialae, Nuuanu and Halawa (Cooke); ? Kauai (Pease).

Achatinella pyramis PFEIFFER, P. Z. S. London, 1845, p. 90. —Mon. Hel. Viv., ii, p. 241; iii, p. 466.—REEVE, Conch. Icon. Achatinella, sp. 41. — *Achatinella* (*Leptachatina*) *pyramis* PFEIFFER, Mon. Hel. Viv., iv, p. 565; vi, p. 184; viii, p. 246.— *Leptachatina pyramis* PEASE, Journ. de Conchyl., 1869, p. 168.—SYKES, Fauna Haw., ii, 1900, p. 367.

Pease was probably wrong in his interpretation of Pfeiffer's diagnosis, as shells which I have carefully compared with the original lot in the British Museum are all from Oahu, and from the characters of the types I have no doubt that they also were from this island.

The shells from Waialae agree very closely with the types, except that they have one-half of a whorl less.

L. pyramis is somewhat related to *glutinosa* Pfeiffer. The spire is, however, much longer. Some of the shells from Nuuanu have a faint dark brown band encircling the periphery.

62. L. KUHNSI n. sp. Pl. 11, fig. 3.

The shell is minutely perforate (sometimes imperforate), broadly ovate, brownish corneous, glossy, subdiaphanous, near the suture slightly irregularly striate, the rest nearly smooth, under a lens minutely striate with lines of growth. Spire broadly conic with slightly convex outlines, apex obtuse, pale corneous. Suture scarcely impressed, faintly margined with a darker band, slightly crenulate. Whorls 5⅔, slightly convex, the first 3 closely coiled and increasing slowly, the rest increasing more rapidly, the last large, tumid, tapering to the base. Aperture large, slightly more than one-half the length of the shell, obliquely truncate-ovate, very slightly oblique, perpendicular, slightly contracted above and ascend-

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ing very slightly in front. Outer margin of lip regularly curved, pale brown within, strongly thickened, bordered with yellowish white; columellar margin thin, reflexed, adnate above; both margins united by a thin whitish callus. Umbilicus (when present) a long narrow slit along the columella. Length 9.4, diam. 5.3, length of aperture 4.9 mm.

West Maui: Abau-ka-imu (Thaanum), Maunahoomaha (Thaanum, Cooke).

A very obese species, probably related to *L. nitida* Newc. and *L. compacta* Pse. In outlines it recalls *L. glutinosa* Pfr. from Oahu. This species seems to be restricted to the rather higher altitudes of West Maui. There is a light corneous variety of this species.

63. L. SMITHI Sykes. Pl. 6, fig. 24.

"Shell dextral, ovately fusiform, somewhat thin, under a lens slightly striate, pale corneous, shining, pellucid, apex somewhat obtuse, whitish corneous; suture simple, lightly impressed; whorls 6-6½, flatly convex, the last more than equal to ⅔ the length of the shell; aperture pyriform; lip with the dextral margin slightly thickened, whitish corneous within, columellar margin narrow, parietal margin lacking. Length 9.25, diam. max. 4.9 mm.

Lanai: mountains behind Koele (Perkins), in the gulches (Thaanum).

Leptachatina smithi SYKES, Proc. Malac. Soc. London, ii, 1896, p. 128; Fauna Haw., ii, p. 369, pl. xi, fig. 29.

This species is most easily separated from *L. perkinsi* by its more acute and closely coiled embryonic whorls. The original figure is copied.

I. *Group of L. semipicta.*

64. L. SEMIPICTA Sykes. Pl. 6, figs. 20, 21, 22.

"Shell imperforate, dextral, acuminately ovate, thin, shining, pellucid, brownish corneous, lightly striate, apex slightly obtuse, suture paler, moderately impressed; whorls 6-6½, flatly convex, the first slightly striate, the last equal to ⅝ the length of the shell, almost smooth, aperture ovately pyri-

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form; lip with dextral margin erect, slightly thickened, columellar margin narrow, adnate, parietal margin lacking. Length 8.0, diam. max. 4.0 mm." (*Sykes*).

Lanai: mountains behind Koele (Perkins).

Leptachatina semipicta SYKES, Proc. Malac. Soc. London, ii, 1896, p. 128; Fauna Haw., ii, p. 369, pl. xi, fig. 12.

"Most of the specimens have the lower half of the last whorl of a lighter color; some, however, are unicolorous." (*Sykes.*)

Some specimens have a narrow light colored band at the periphery. There are, in Mr. Thaanum's collection, a few elongated specimens. In these, the spire is subcylindrical; there are 8 slightly convex whorls. One of the shells has the following measurements: length 11.0, diam. 4.2, l. of ap. 3.7 mm. These shells seem to be related to *L. longiuscula*, especially as the upper whorls are slightly costate. *L. longiuscula* is, however, more closely related to *L. perkinsi*. *L. semipicta* appears at first glance to belong to *Thaanumia*, but the embryonic whorls are not flattened and compressed as in the other species of this subgenus, and I have been unable to find the least trace of minute spiral striæ. The original figure is copied in fig. 22.

J. *Group of L. pachystoma.*

65. L. PACHYSTOMA (Pease). Pl. 8, figs. 47, 48.

"Shell dextral, solid, conically ovate, imperforate, obliquely striate, straw color; spire elongately conical, apex subobtuse; suture scarcely crenulate; whorls 6, somewhat flat, the last more convex, equal to 3/10 of the length; aperture scarcely oblique, elliptical, angulate at both ends; columellar fold subbasal, small, thick, callous, oblique, white; lip continous, with the margins united by a white, thick rib-like callus, dextral margin rotundate, callous columellar margin adnate. Length 13.0, diam. 7.0 mm." (*Pse.*)

Kauai: Haleiele, Makaweli, Halèmanu (Cooke).

Labiella pachystoma PEASE, Journ. de Conchyl., xvii, 1869, p. 171.—*Achatinella* (*Labiella*) *pachystoma* PFR., Mon. Hel.

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Viv., viii, p. 218.—*Lept.* (*Labiella*) *pachystoma* SYKES, Fauna Haw. ii, 1900, p. 367.

This species is separated from *L. labiata* Newc., by the form of its aperture, which is more oblique, by its smaller columellar fold, and by the callus which unites the two margins, and which forms a distinct rib instead of being uniformly spread over the whole surface." (*Pse.*)

This species does not belong to the section *Labiella*, as the very characteristic tooth within the outer lip has not been observed in a single specimen. The rib-like callus is present only in old specimens and is not peculiar to this species, as this character may be found in gerontic specimens of nearly all the heavier species of this genus, especially those from Kauai.

From a comparison of specimens (probably the types) of *L. pachystoma* and *L. turgidula*, belonging to Pease's own collection, which is now in the Museum of Comparative Zoology in Cambridge, Mass., there is no doubt that the two cannot be held as distinct species. It is thought best to reduce the latter to varietal rank.

65*a*. *L. p. turgidula* (Pease). Pl. 8, figs. 50, 51, 52.

The shell is usually a little longer, more solid, more cylindrical in outline than in typical *L. pachystoma*; sometimes the spire and upper portion of the last whorl are a reddish yellow with a lighter yellowish base. Length 14.0, diam. 7.0, length of aperture 6.4 mm.

Labiella turgidula PEASE, P. Z. S. L., 1869, p. 651 (*nom. sol.*).—*Achatinella* (*Labiella*) *turgidula* PFR., Mon. Hel. Viv., viii, p. 219.—*Leptachatina turgidula* PEASE, Journ. de Conchyl., xviii, 1870, p. 89.—CROSSE, Journ. de Conchyl., xxiii, 1876, pl. 4, fig. 5.

A large specimen from Milolii measures 16.2 x 7.5 mm.

This variety is much more abundant than the typical form. It is found in all the wooded region between Makaweli and Milolii.

65*b*. *L. p. cylindrella* n. var. Pl. 8, fig. 49.

The shell is smaller, narrower, more cylindrical and much

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thinner than that of *L. pachystoma*; the costæ are less pronounced, the surface being smoother. Length 12.3, diam. 5.7, length of aperture 5.6 mm.

This variety was especially abundant at Haleieie.

65*c*. *L. p. brevis* n. var. Pl. 8, fig. 53.

A small, obese, nearly smooth variety, with a short spire and a rather large aperture, which is nearly ½ the length of the shell. Length 9.0, diam. 4.8, length of aperture 4.4 mm.

Haleieie, Kauai.

K. *Group of L. ventulus.*

66. L. APPROXIMANS Ancey. Pl. 3, fig. 46.

"Shell oblong turrited, imperforate, thin, with an oily luster, smooth, but under a lens closely and obsoletely striate, tawny corneous, encircled below the suture by a reddish brown line. Spire turrited, regularly conoidal, scarcely subconvex or rectilinear, subclavate, obtuse. Whorls 8, slowly increasing, somewhat convex, suture lightly impressed. The last oblong, rotundate. Columellar fold strong, twisted, dirty white. Lip slightly thickened. Length 12.5, 13.25, diam. 6.0, 6.5, length of ap. 5, 5.5 mm." (*Ancey.*)

Oahu: Waianae (Durand); Waialua (Lyman).

Leptachatina approximans ANCEY, Le Naturaliste, 1897, p. 222.

This species is somewhat closely related to *L. cingula* Migh. It differs in its shorter and more conic spire, blunter apex and less attenuate base. The aperture is smaller, and broader in proportion to its length.

67. L. CINGULA (Mighels). Pl. 5, figs. 85, 86, 87, 88.

"Shell dextral, ovate conic, horn-color, smooth and polished, with a narrow brown band accompanying the suture; whorls 7, convex; aperture small, subovate; lip simple. Length 11/20, diam. ¼ inch." (13.9 x 6.3 mm.) (Migh.).

Oahu (Mighels): Manoa (Newcomb, for fumosa and vitrea); Palolo (Gulick, Cooke); Mt. Tantalus (Thaanum, Cooke); Konahuanui (Cooke). The specimens collected by

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Perkins in Kawailoa Gulch and referred to this species by Sykes belong to *L. dimidiata* Pfr.

Achatinella cingula MIGHELS, P. Bost. Soc., ii, 1845, p. 21. —PFEIFFER, Mon. Hel. Viv., ii, p. 242.—NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 313. Not *Achatinella cingula* PFR., Conch. Cab., *Achatinella*, p. 288, pl. 57, figs. 5-7; Mon. Hel. Viv., iii, p. 467.—*Achatinella* (*Leptachatina*) *cingula* PFEIFFER, Mon. Hel. Viv., iv, p. 567.—*Leptachatina cingula* PEASE, P. Z. S., London, 1869, p. 651.—*Achatinella fumosa* NEWCOMB, P. Z. S. London, 1853, p. 140, pl. 23, fig. 28.—*Achatinella* (*Leptachatina*) *fumosa* PFEIFFER, Mon. Hel. Viv., iv, p. 563.—*Labiella fumosa* PEASE, P. Z. S. London, 1869, p. 651.—*Leptachatina fumosa* BALDWIN, Cat. Haw. Shells, 1893, p. 11.—SYKES, Fauna Haw., ii, Moll., p. 362.—*Achatinella vitrea* NEWCOMB, P. Z. S. London, 1853, p. 142, pl. 23, fig. 34.—PFEIFFER, Mon. Hel. Viv., iv, p. 564.—*Labiella vitrea* PEASE, P. Z. S. London, 1869, p. 651.—*Leptachatina vitrea* BALDWIN, Cat. Haw. Shells, 1893, p. 12.—SYKES, Fauna Haw., ii, Moll., p. 372.

I have included Newcomb's two species with *cingula*, as Newcomb himself considered that *vitrea* might possibly be the same as *cingula* (*vide* Ann. Lyc. N. Y., vi, 1858, p. 313), and there is no doubt, in my mind, that both *vitrea* and *fumosa* belong to the same species, as a series of these shells collected near the head of Palolo Valley intergrades perfectly. I do not think that *L. dimidiata* can possibly be a form of *cingula*. Figs. 86, 87, 88 are from Palolo. Fig. 85 from Manoa.

Measurements of some specimens are as follows:

Length 15.2, diam. 6.3 mm. (Newcomb for *fumosa*).

Length 12.7, diam. 6.3 mm. (Newcomb for *vitrea*).

Length 13.8, diam. 6.7, length of apert. 6.3 mm. A. N. S. P. no. 91790.

Length 13.0, diam. 5.9, length of apert. 5.6 mm. A. N. S. P. no. 91790.

Length 12.8, diam. 6.4, length of apert. 6.0 mm. A. N. S. P. no. 57803 from Newcomb as *L. fumosa*.

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68. L. VENTULUS (Férussac). Pl. 5, figs. 81, 82; pl. 11, fig. 4.

"Shell dextral, minute, ovately elongate, furnished with marked striæ; epidermis brown; whorls 5½, slightly convex, sutures distinct; aperture small, semilunate; lip thickened within; umbilical cleft not distinct. Length 5.5, diam. 2.5 lignes." (12.4 x 6.2 mm.) (*Fér.*)

Helix (*Helicteres*) *ventulus* FÉRUSSAC, Voy. Freycinet, Zool. p. 481.—*Bulimus ventulus* PFR., Symb., 1841, p. 86.—*Achatinella ventulus* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 306 (animal).—*Amastra ventulus* PEASE, P. Z. S. London, 1869, p. 649.—SYKES, Fauna Haw., ii, p. 347.—*Achatinella melampoides* PFEIFFER, P. Z. S. London, 1851, p. 262; Martini und Chemnitz, Conch. Cab., *Achatinella*, pl. 67, figs. 8, 9.—*Achatinella accincta* GOULD, U. S. Exp. Exp., Moll., pl. vii, fig. 97. Not *Achatinella ventulus* REEVE, Conch. Icon., *Achatinella*, no. 31 (= *A. textilis* Fér.).—PFEIFFER, Conch. Cab., *Achatinella*, pl. 67, figs. 12, 13 (= *A. textilis* Fér.).

Oahu: Nuuanu to Palolo (Baldwin); Pauoa Valley and ridges of Nuuanu (Perkins); Palolo, Tantalus, Konahuanui, Nuuanu, Kalihi (Cooke); Kaliuwaa (Kuhns, Spalding); Punaluu (Spalding); Waialae (Spalding).

In young specimens the embryonic whorls are encircled by a white band. This band continues on the lower whorls but is usually absent or very faintly represented in the adult shells. There are, usually, numerous hydrophanous grayish-buff, longitudinal and transverse lines. In some localities all the adult shells are this uniform grayish-buff. The normal color is a rich, reddish brown with a yellowish umbilical zone. The aperture is reddish brown, except in shells having the hydrophanous covering, when it has a purplish tinge. The lip is white, bordered on the outside with yellowish white or light reddish brown. The columellar fold is rather strong, white. The shells are usually irregularly finely striate; in a few specimens from the eastern side of Nuuanu, the lower whorl is malleate. The species is never abundant, though widely distributed over the whole of the main mountain range. A single specimen from Waialae has an ivory white spire and a dark reddish brown base. A rather abun-

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dant color variety from Punaluu (pl. 11, fig. 4) and Kaliuwaa has a tawny spire with a dark reddish brown base. Figs. 81, 82 are from Nuuanu examples.

The measurements of a few shells are as follows:

Length 14.7, diam. 6.6, length of apt. 6.6 mm. wh. 6.5 Nuuanu.

Length 12.4, diam. 6.4, length of ap. 6.0 mm. wh. 6. Nuuanu.

Length 13.5, diam. 7.3, length of ap. 7.1 mm. wh. 5.7. Nuuanu.

Length 12.0, diam. 5.7, length of ap. 5.7 mm. wh. 5.7. Palolo.

69. L. PILSBRYI n. sp. Pl. 11, figs. 5, 6.

The shell is imperforate, elongately ovate, dark reddish brown, except for the embryonic whorls which are corneous, somewhat solid, glossy, distinctly costulate, except for the smooth embryonic whorls. Spire ovately conic, apex subobtuse. Suture scarcely impressed, crenulate. Whorls 6½, hardly convex, the last subcylindrical, slightly ascending near the lip, tapering rather abruptly towards the base. Aperture large, elongate, subpyriform, scarcely oblique, perpendicular. Columella concave above, nearly straight, with a blunt callus along its face, purplish white, subtruncate with a rather weak oblique fold. Outer margin of lip nearly straight, arcuate below, thickened within, columellar margin thin, appressed, adnate; the margins united by a thin callus on the parietal wall. Length 11.6, diam. 5.4, length of ap. 5.3 mm.

Oahu: Kukaeiole in Kaaawa (Kuhns).

Other specimens of this species are lighter colored, of a purplish brown with a narrow dark sutural band, and slightly larger, with the margin of the lip edged with light purple. One measures length 12.2, d. 5.7, length of ap. 5.6 mm.

This species is most closely related to *L. ventulus* Fér. Its surface is, however, distinctly costulate, the apex is not banded as in most specimens of the latter species, the suture is slightly more impressed, the columellar fold is not as

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strongly developed and the umbilical region is not lighter colored.

70. L. CONSPICIENDA n. sp. Pl. 11, fig. 10.

The shell is imperforate, elongately conic, straw color, rather thin for a shell of its size, very glossy, nearly smooth, under a lens minutely and irregularly striate with lines of growth. Spire narrowly conic, apex somewhat acute. Suture simple, slightly impressed. Whorls 6½, slightly convex, at first increasing slowly and regularly, the penultimate increasing more rapidly, the last long, subcylindrical, tapering slowly to the base, ascending slightly in front. Aperture subpyriform, hardly oblique, perpendicular, white within. Columella nearly straight, with a thickened oblique median fold, and with scarcely any thickening along its face. Outer lip very slightly arcuate, faintly thickened within; columellar margin thin, appressed, adnate; parietal margin covered with a thin colorless callus. Length 12.3, diam. 5.6, length of ap. 5.5 mm.

East Maui: Mt. Kukui (Baldwin). Type no. 15160 B. P. B. Museum coll.

L. kuhnsi, from the same locality and from which it is easily distinct, is probably its nearest relative from the island of Maui. *L. conspicienda* is more nearly related to *L. perkinsi*, Sykes, from the island of Lanai. It has, however, a more acute apex, the spire is less regularly conic, the whorls are more convex, the aperture is narrower and more elongate and the columella is longer and straighter.

71. L. PERKINSI Sykes. Pl. 6, fig. 23.

"Shell dextral, ovately fusiform, somewhat thin, under a lens slightly striate, brownish, smooth, semipellucid, apex somewhat obtuse, whitish corneous; suture simple, lightly impressed; whorls 6-6½, flatly convex, the last equal to two-thirds the length of the shell; aperture pyriform; lip with dextral margin slightly thickened, whitish corneous within, columellar margin narrow, parietal margin lacking. Length 10.5, diam. max. 5 mm." (*Sykes.*)

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Lanai: mountains behind Koele (Perkins), at high altitudes (Thaanum).

Leptachatina perkinsi SYKES, Proc. Malac. Soc. London, ii, 1896, p. 128; Fauna Haw., ii, p. 367, pl. xi, fig. 30.

"This and *L. smithi* are very closely allied, and may be separated by the fact that *L. smithi* is of a lighter color, smaller size, and is a trifle wider in proportion to its length. In *L. smithi* the last whorl is slightly longer in proportion to the total length of the shell." (*Sykes.*) The original figure is copied.

A fine series of this species was collected by Mr. Thaanum. They are very glossy, and vary from a light corneous to a dark resinous color. He writes that: "the large colored shells are mostly from the higher altitudes, the smaller from the gulches." The latter are *L. smithi* Sykes. A series of *L. perkinsi* averaged 11.5 x 5.5 mm. A peculiar abnormal specimen, almost cylindrical in form, with 7½ whorls measured 16.0 x 5.9 mm.

A peculiar color variety is also in Mr. Thaanum's collection. The shells are a greenish corneous with a narrow brown band at the suture and sometimes a broad brown band at the periphery. They are smaller than the other specimens of *perkinsi* but have the blunt apex of this species.

72. L. LONGIUSCULA n. sp. Pl. 11, fig. 11.

The shell is imperforate, elongate, narrowly conical, yellowish corneous, the neanic whorls distinctly costate, especially near the sutures, the last whorl nearly smooth, under a lens minutely striate with lines of growth. Spire narrowly conical, apex subacute. Suture impressed, simple. Whorls 7, slightly convex, increasing very slowly and regularly, the last subcylindrical, tapering towards the base. Aperture pyriform, narrow, very slightly oblique, almost perpendicular. Columella broad above, truncate below, with a fairly strong oblique fold almost extending to the margin, and an acute callus along its face. Outer lip thickened within, regularly arched, forming a subacute angle with the columella; columellar margin thickened, appressed, adnate; both margins

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united by a rather thick, white parietal callus. Length 10.5, diam. 4.7, length of apert. 4.5 mm.

Lanai (Thaanum).

There are but four specimens of this species so far reported. All agree very closely, (though in one specimen the last two whorls are slightly pathologic) the most distinctive character being the costate neanic whorls. This species is somewhat related to *L. perkinsi* Sykes. It is, however, narrower in proportion to its length and has an additional whorl, and besides I have been unable to find a single specimen of *L. perkinsi* with costate neanic whorls.

L. *Group of L. succincta.*

73. L. CORNEOLA (Pfeiffer).

"Shell ovately oblong, very lightly striate, pellucid, glossy, corneous, spire turrited-conical, apex somewhat obtuse; suture subsimple; whorls 8, somewhat flat, the last nearly equal to ⅖ of the length; columella strongly arcuate, furnished with an acute, prominent, white, flattened tooth; aperture irregularly oval; lip slightly thickened within with a thin, glossy, white callus. Length 15.0, diam. 7.0, length of apert. 6, diam. 3½ mm." (*Pfeiffer*).

Oahu? (Baldwin): one young specimen (Hutchison).

Achatinella corneola PFEIFFER, P. Z. S. London, 1845, (1846), p. 90.—REEVE, Conch. Icon., *Achatinella*, sp. 4.—PFEIFFER, Mon. Hel. Viv., ii, p. 241; iii, p. 466.—*Achatinella* (*Leptachatina*) *corneola* PFEIFFER, Mon. Hel. Viv., iv, p. 564; vi, p. 183; viii, p. 245.—*Labiella corneola* PEASE, P. Z. S. London, 1869, p. 651.—*Leptachatina corneola* SYKES, Fauna Haw., 1900, p. 360.

L. corneola appears to be related to the larger *Leptachatinæ* from the western portion of Oahu. The single specimen in the British Museum is very glossy and larger than the other species (*L. resinula* Gul., and *L. succincta* Newc.) to which it is somewhat related.

74. L. MARGINATA (Gulick). Pl. 11, fig. 8.

"Shell dextral, imperforate, ovate, shining, semipellucid,

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corneous, with a diffused brown band, very finely striated; apex obtuse; spire convexly conical; whorls 6, somewhat convex; the last strongly margined above; columellar fold central, not strongly developed, brown; aperture lunately rounded; peristome simple; with dextral margin unreflected, whitish, obtuse, arcuate; columellar margin dilated, brown, adnate; parietal margin very thin, vitreous. Length 9.3, diam. 5.0, length of body whorl 6.3 mm." (*Gulick.*)

Oahu: Kalaikoa (Gulick).

Achatinella marginata GULICK, Ann. Lyc. N. Y., vi, 1856, p. 179, pl. 6, fig. 7.—*Achatinella succincta* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 334.—*Achatinella* (*Leptachatina*) *succincta* PFR., Mon. Hel. Viv., vi, p. 183.—*Leptachatina marginata* SYKES, Fauna Haw., ii, 1900, p. 366.

"The most striking character of this species is the broad sutural margin, in which respect it is unlike other species of this group." (*Gulick.*)

The only specimen of this species which I have been able to find is in the collection of the Boston Society. There is no doubt but that it is more or less closely related to *L. succincta* but, as Sykes has remarked, it "is smaller and more slender."

✓ 75. L. RESINULA (Gulick). Pl. 3, fig. 42.

"Shell dextral, imperforate, cylindrically ellipsoidal, rather thin, shining, pellucid, corneous, very lightly striate; apex obtuse; suture simple, distinct, slightly impressed; whorls 6½, somewhat convex; columellar plait sub-basal, white, lamelliform; aperture nearly vertical, elliptical; peristome simple; with dextral margin regularly curved, unreflected; columellar margin dilated, thin, adnate; parietal margin very thin. Length 12.6, diam. 6.0, length of body whorl 8.3 mm." (*Gulick.*)

"Var. *b*. Shorter, less cylindrical." (*Gulick.*)

"Var. *c*. With dark sutural line." (*Gulick.*)

Oahu: Kawailoa, Waimea, Pupukea, Waialei and Punaluu (Gulick); Waialua (Lyman, Cooke).

Achatinella resinula GULICK, Ann. Lyc. N. Y., vi, 1856, p.

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174, pl. 6, fig. 2.—*Achatinella* (*Leptachatina*) *succincta* PFR., Mon. Hel. Viv., vi, p. 183.—*Leptachatina resinula* PEASE, P. Z. S. London, 1869, p. 651.—SYKES, Proc. Malac. Soc. London, iii, 1899, pl. 14, fig. 11.

This species' nearest relative appears to be *L. succincta* Newc. It is usually smaller, more cylindrical in outline and the spire is decidedly less conical.

Measurements of some of Gulick's specimens are:

Length 12.7, diam. 6.0, length of apert. 6.1 mm. Pupukea.
Length 11.2, diam. 5.7, length of apert. 5.6 mm. Pupukea.
Length 11.7, diam. 5.8, length of apert. 5.5 mm. Kawailoa.

76. L. SUCCINCTA (Newcomb). Pl. 5, figs. 90, 91.

"Shell obesely conoid, thin, shining, corneous, longitudinally striate; whorls 7, flatly convex, slightly rugose above, not margined; suture but slightly impressed; aperture broadly ovate; columella deeply excavated, short, terminating in a broad plicate tooth; lip simple, slightly thickened within, with or without a broad obsolete white or brown central band on the last whorl, or a fine revolving sutural line of the same color. Length 12.5, diam. 7 mm." (*Newc.*)

Oahu: Ewa (Newcomb); Wahiawa (Gulick); Halemano (Perkins).

Achatinella succincta NEWC., Proc. Bost. Soc., v, 1855, p. 220; Am. Journ. of Conch. ii, 1866, p. 213, pl. 13, fig. 7.—*Achatinella* (*Leptachatina*) *succincta* PFR., Mon. Hel. Viv., iv, p. 564.—*Labiella succincta* PEASE, P. Z. S. L., 1869, p. 651.—*Leptachatina succincta* HARTMAN, Proc. A. N. S. Phila., 1888, p. 55.—SYKES, Fauna Haw., ii, p. 370.

A large obese species of the type of *L. resinula* Gul., *L. pyramis* Pfr. and *L. glutinosa* Pfr. It is most nearly related to the latter, from which it differs in size, slightly blunter spire and slightly more striate surface. Newcomb's figure is not good. The specimens in Coll. Academy of Natural Sciences, presented by the author, are labeled as a variety. One of the shells has the following measurements: length 12.6, diam. 7, alt. of ap. 6.3 mm.

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77. L. SACCULA Hartman. Pl. 4, fig. 79.

"Shell dextral, ovate conic, thin and semi-pellucid, spire more than half the length. Whorls 6, slightly convex, the last inflated, suture well impressed, surface coarsely striate. Aperture roundly ovate, subumbilicate, columella white, with an oblong plica within; interior of labium white and slightly thickened; color pale green. Length 10, diam. 6 mm., length of aperture 4, diam. 2.5 mm." (*Hartm.*)

Hawaiian Islands (Hartman).

Leptachatina saccula HARTMAN, Proc. Acad. N. S. Phila., 1888, p. 55, pl. 1, fig. 15.

I have been unable to refer any shell to this species and have seen no authentic specimen. From the description the shell may possibly belong to the group of *L. succincta* Newc. Hartman's figure is copied.

M. *Group of L. fossilis.*

78. L. FOSSILIS n. sp. Pl. 8, figs. 58, 59.

The shell is umbilicate, conically ovate, white (in a fossil state), somewhat solid, glossy, nearly smooth, under a lens minutely striate with lines of growth. Spire ovately conic, apex subacute. Suture slightly impressed, simple. Whorls 7, almost flat, the last rotundate, slightly tapering towards the base. Aperture small, acutely angled at both ends, perpendicular, oblique, having, on the parietal wall, a very thick, acute callus, which is joined to the columella but separated from the outer lip by a narrow sinus. Columella straight, simple, with a rather small, almost transverse, deeply situated lamella. Outer lip regularly curved, thickened within. Umbilicus very large for the genus, circular. Length 7.7, diam. 4.0, length of aperture 3.1 mm.

Kauai (Newcomb).

This species is represented by a single specimen in the collection of Academy of Natural Sciences (no. 57820). It was mixed with some specimens labeled *L. extincta* Pfr., sent by Dr. Newcomb. *L. fossilis* differs from all the other species of this genus in its relatively small aperture, its heavy parietal

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callus which is not joined to the outer lip, and its large umbilicus.

N. *Group of L. sculpta.*

79. L. LUCIDA Pease. Pl. 8, figs. 65, 66.

"Shell elongate, thin, imperforate, dextral, glossy, translucid, longitudinally costulate; spire somewhat obtuse; whorls 7, convex, marginate and scarcely crenulate at the suture; suture subimpressed; aperture almost vertical; columella thin; columellar fold obsolete; lip thin; pale yellowish corneous, sometimes reddish brown at the suture. Length 6.0, diam. 2.0 mm." (*Pse.*)

Kauai: Kealia (Baldwin); Kilohana, district of Lihue (Cooke).

Leptachatina lucida PEASE, P. Z. S., 1869, p. 650 (*nom. sol.*); Journ. de Conchyl., 1870, p. 93.—*Achatinella* (*Leptachatina*) *lucida* PFR., Mon. Hel. Viv., viii, p. 249.

A single shell, from the last locality, agrees very well with Pease's description in the texture of the surface and color, it has, however, 8 whorls and is slightly larger than Pease's type, having the following measurements: length 6.2, diam. 2.3, length of aperture 2.0 mm.

The species is related to *L. knudseni*, but is easily separated by its costulate surface.

80. L. STRIATA (Newcomb).

"Shell acutely turrited, reddish horn color, minutely and impressly striated transversely; apex acute; suture moderate; whorls six to eight, the last ⅖ of the whole length; aperture produced, subovate; columella excavated, truncated, twisted below into a fold. Length 5.0, diam. 2.0 mm." (Newc.)

Kauai (Newc.).

Tornatellina striata NEWCOMB, Proc. California Acad. Sci., ii, 1861, p. 93.—*Leptachatina striata* SYKES, Fauna Haw., ii, p. 370.

I was unable to find a single specimen of this species in Newcomb's collection, now in the Museum at Cornell University. Probably the type was in the California Academy, and is now destroyed.

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The species cannot be confused with *L. lucida* Pease nor *L. knudseni*.

81. L. COSTULATA (Gulick). Pl. 4, fig. 80.

"Shell dextral, imperforate, turreted oblong, shining, silky, dark corneous, with a pale spiral band cutting the body whorl, and revolving above the suture, minutely regularly ribbed; spire turrited, with pale, obtuse apex; suture simple, moderately impressed; whorls 7, convex; columellar fold central, brown; aperture pyriform; peristome simple; with dextral margin unreflected, pale, laterally compressed, slightly arcuate anteriorly; columellar margin thin, brown, adnate; parietal margin very thin, white. Length 8.3, diam. 3.3, length of body whorl 5.0 mm." (*Gulick.*)

Oahu: Pupukee, Waimea and Kawailoa (Gulick).

Achatinella costulata GULICK, Ann. Lyc. N. Y., vi, 1856, p. 177, pl. 6, fig. 5.—NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 322.—*Achatinella* (*Leptachatina*) *costulata* PFEIFFER, Mon. Hel. Viv., iv, p. 565.—*Achatinella* (*Leptachatina*) *semicostata* PFEIFFER, Mon. Hel. Viv., vi, p. 184.—*Leptachatina costulata* SYKES, P. Malac. Soc. London, iii, pl. 14, fig. 4; Fauna Haw., ii, 1900, p. 360.

"Newcomb united this shell with *L. semicostata* Pfeiffer, but Gulick's type is much more slender than that species, the mouth is of a different shape, and other minor differences exist, all leading me to regard it as a good species." (*Sykes.*)

This species is much more closely related to *L. sculpta* Pfr. It differs, however, in its less attenuate and slightly more convex spire; the costæ are slightly finer and closer; the color is brownish, while in *sculpta* the shell is straw color. Figured from a cotype.

82. L. OCTOGYRATA (Gulick). Pl. 9, fig. 13.

"Shell dextral, scarcely perforate, ovately turrited, thin, somewhat shining, translucent, dark corneous, very finely but regularly striated; apex obtuse, pallid; spire conical, with outlines slightly convex; suture simple, moderately impressed; whorls 8, somewhat convex; columella light brown, with a

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slight fold; aperture subpyriform; peristome simple; with dextral margin unreflected, thin, lightly arcuate; columellar margin reflected, parietal margin wanting. Length 7.6, diam. 3.5, length of body whorl 4.3 mm." (*Gulick.*)

Oahu: Palolo (Gulick).

Achatinella octogyrata GULICK, Ann. Lyc. N. Y., vi, 1856, p. 190, pl. 6, fig. 18.—*Achatinella obclavata* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 322.—PFR., Mon. Hel. Viv., vi, 186.—*Leptachatina octogyrata* SYKES, P. Malac. Soc. London, iii, 1899, pl. 14, fig. 7; Fauna Haw., ii, 1900, p. 366.

This species is somewhat related to specimens of *L. petila* Gul., or at least to specimens which are referable to this species. *L. octogyrata* is slightly more solid, more finely and closely costate, the spire is more regularly turrited and the whorls are flatter and more closely coiled. The embryonic whorls are pale; in two of the three specimens which I have examined they appear to be perfectly smooth; in the third specimen there is an indication of minute striæ. Unfortunately I have not been able to examine any young specimens of this species; the striæ of the embryonic whorls are deciduous. Figured from a cotype.

83. L. SCULPTA (Pfeiffer). Pl. 4, figs. 73, 74, 75.

"Shell conically oblong, solid, sculptured with strong, subarcuate, longitudinal folds, straw color; spire regularly attenuate, obtuse; whorls 8, somewhat flat, the last a little more than ⅓ of the length, somewhat ascending in front; aperture subvertical, sinuately oval; columella slightly arcuate, obliquely truncate; lip simple, erect, dextral margin slightly arching forward, columellar margin slightly callous. Length 8.5, diam. 3.5 mm." (*Pfr.*)

Oahu: Waialua (Lyman); Haleauau in the Waianae Mts. (Cooke).

Achatina sculpta PFR., P. Z. S., 1855, p. 21; PFR., Mon. Hel. Viv. iv, p. 609.—*Leptachatina sculpta* PSE., P. Z. S., 1869, p. 650.

My specimens, though slightly smaller, agree almost perfectly with the type in the British Museum. The species

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seems to be related to *L. lucida* Pse. from Kauai. It is however, larger, thicker and more strongly sculptured. The embryonic whorls are smooth and glossy, the aperture perpendicular.

One specimen from Waialua has the following dimensions; length 8, diam. 3.3, alt. of aperture 3.1.

84. L. SEMICOSTATA (Pfeiffer).

"Shell subumbilicate, dextral, turrited, somewhat solid, closely costate, shining, chestnut corneous; spire elongate, convexly conical, somewhat obtuse; suture impressed; whorls 8½, slightly convex, the last hardly equalling ⅖ of the length, below the periphery smooth, pale, attenuate, base saccate-compressed; aperture slightly oblique, sinuately oblong; columellar fold broad, oblique, white; lip simple, unexpanded, margin of the columella reflexed, spreading throughout. Length 9.5, diam. 4 mm." (*Pfr.*)

Hawaiian Islands (Pfeiffer).

Achatinella (*Leptachatina*) *semicostata* PFEIFFER, P. Z. S. London, 1855 (1856), p. 206; Mon. Hel. Viv., iv, p. 565.—NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 322, 330.—*Leptachatina semicostata* PEASE, P. Z. S., 1869, p. 651.

A remarkable species with a very narrow aperture. I know of no species to which it may be related, and from the shell characters there is no clue as to which island it may have come from. I agree with Mr. Sykes that this species is not *L. fusca* Newc. as Newcomb suggested.

✓ 85. L. LANCEOLATA n. sp. Pl. 6, figs. 12, 13.

The shell is imperforate, elongate, attenuately conic, yellowish corneous, thin, subdiaphanous, glossy, under a lens regularly and minutely striate or costulate. Spire acutely conic, apex obtuse. Suture hardly impressed, narrowly margined, slightly crenulate. Whorls 6¾, nearly flat, the last subcylindrical, tapering towards the base. Aperture slightly oblique, perpendicular, pyriform. Columella nearly straight, with a very oblique, minute fold. Outer lip slightly arcuate, slightly thickened within, columellar margin reflexed, adnate. Length 6.0, diam. 2.4, length of ap. 2.4 mm.

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Molokai: Kamalo (Thaanum), near Waikolu (Cooke).

L. lanceolata is most nearly related to *L. baldwini*, from West Maui. It differs in its more attenuate form, narrower aperture, etc.

86. L. IMPRESSA Sykes. Pl. 6, fig. 18.

"The shell is imperforate, dextral, oblong, pellucid, shining, pale corneous, striate; spire elongate, apex obtuse; suture impressed; whorls 7½, slightly convex, the last equal to one-half the length of the shell; aperture sinuately pyriform; lip simple, thin, dextral margin erect, arcuate, columellar margin narrow, adnate, parietal margin lacking. Length 7.0, diam. 2.5 mm." (Sykes.)

Lanai (Thaanum): mountains behind Koele (Perkins).

Leptachatina impressa SYKES, Proc. Malac. Soc. London, ii, 1896, p. 127; Fauna Haw., ii, p. 364, pl. xi, fig. 8.

A small elongate species related to *L. lanceolata* from Molokai and to *L. baldwini* from Maui, but slightly more costate than either of these two species.

The species is well represented in Mr. Thaanum's collection. In fresh specimens, the shells are a unicolorous light brown to rather dark shade of brown; a few specimens have a broad dark brown band just above the periphery. Pl. 6, fig. 18 is a copy of the original figure.

87. L. SUPRACOSTATA Sykes. Pl. 6, fig. 19.

"Shell elongate, turrited, imperforate, dextral, thin, corneous, polished; whorls 8, the last equal to ½ the length of the shell, the first subcostulate near the sutures, the rest almost smooth; suture impressed, marginate, marked with a spiral line; aperture lunate, columella subarcuate; dextral margin slightly thickened, columellar margin subreflexed, furnished with a very small, obliquely twisted fold. Length 6.3, diam. 2.0 mm." (*Sykes.*)

Lanai: mountains behind Koele (Perkins).

Leptachatina supracostata SYKES, Fauna Hawaiiensis, ii, p. 370, pl. xi, fig. 22.

"Only two specimens. It belongs to the group of *L. exilis*

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Gulick; it is inconspicuously costulate below the suture, the sculpture gradually fading out, until the last whorl hardly shows any marking beyond the lines of growth. There is a faint spiral line just below the suture." (*Sykes.*)

I have referred to this species three lots of shells in Mr. Thaanum's collection. The shells do not agree with Mr. Sykes' measurements but they have the other characteristics fairly well represented.

A well developed specimen, with 10½ whorls has the following measurements: length 9.3, diam. 3.0, l. of ap. 2.8 mm. If these shells do not belong to *L. supracostata* they must be an undescribed species. Fig. 19 is a copy of that of Mr. Sykes.

88. L. LANAIENSIS n. sp. Pl. 12, figs. 2, 3.

The shell is minutely perforate, elongate, light corneous, thin, subdiaphanous, of a silky lustre, finely and closely costate (except the embryonic whorls), the costæ thin. Spire elongately conic, slightly attenuate above, apex obtuse. Suture simple, slightly impressed. Whorls 8½, convex, closely coiled, the last subcylindrical, tapering to the base. Aperture narrowly ovate, acute at both ends, very slightly oblique and slightly diagonal. Columella nearly straight, slightly callous along its face, with a rather small oblique fold extending to the margin. Outer lip very slightly thickened within, regularly curved to the base of the columella; columellar margin thin, adnate for about one-half of its length, both margins united by a thin transparent parietal callus. Umbilicus minute. Length 8.0, diam. 3.2, length of ap. 3.0 mm.

Lanai (Thaanum).

This species is much more abundant than *L. impressa*, Sykes to which it is closely related. It differs in being broader in proportion to its length, thinner, with finer and closer striæ, the whorls are more convex, and it is always minutely perforate.

There are two color forms besides the one noted above: one a brownish corneous and the other light corneous with a dark

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sutural band. A few specimens also vary in having an almost smooth surface.

89. L. TENUICOSTATA Pease. Pl. 1, figs. 10, 11.

"Shell thin, dextral imperforate, elongately ovate, longitudinally plicately costate, golden; whorls 5, convex; suture well impressed; columellar fold white, small, oblique; lip slightly thickened. Length 7.5, diam. 3.5 mm." (*Pease.*)

Hawaii: Mana fossil (Henshaw, Thaanum).

Leptachatina tenuicostata PEASE, Journ. de Conchyl., 1869, p. 170.—*Achatinella* (*Leptachatina*) *tenuicostata* PFR., Mon. Hel. Viv., viii, p. 250.—*Leptachatina tenuicostata* SYKES, Fauna Haw., ii, 1900, p. 371.—ANCEY, Journ. Malac. xi, 1904, p. 69.

I have been unable to find a single authentic specimen of this species. It is not represented in the Pease collection in Cambridge. Only a few shells from the Mana deposits seem referable to this species. They may be related to *L.* (*Thaanumia*) *henshawi* Sykes, for in the fossil material all trace of the spiral lines on the embryonic whorls might have been lost. As the shells are imperforate it is probably better to leave the species in *Leptachatina s.s.* In the fossil material, the columella is nearly straight, with an acute longitudinal thickening along its face; the columellar fold is very deeply seated and oblique; the aperture is narrow, acute at both ends; there are 6-6½ whorls. An average specimen measures: length 8.0, diam. 3.8, length of ap. 3.7 mm. A Mana shell is figured, figs. 10, 11.

90. L. IMITATRIX Sykes. Pl. 1, fig. 14.

"Shell elongate, turrited, imperforate, dextral, somewhat thin, yellowish corneous, under a lens minutely longitudinally striate; whorls 6½, flatly convex, the last equal to 4/7 the length of the shell; suture impressed; aperture elongately oval, with the dextral margin arcuate, acute, columellar margin slightly thickened, reflexed, furnished with a very small, inconspicuous fold, the margins united by a thin callus. Length 7.0, diam. 2.6 mm." (*Sykes.*)

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Hawaii: Mauna Loa at 4000 feet (Perkins), Hamakua subfossil (Ancey), Kona (Baldwin).

Leptachatina imitatrix SYKES, Fauna Hawaiiensis, ii, 1900, p. 364, pl. xi, fig. 9.—ANCEY, Journ. Malac. xi, p. 69.

"Only a single specimen. It recalls *L. exilis* of Gulick, but is more conic, i. e. the upper whorls are narrower in proportion—and it is of a light straw yellow. The columellar plait is deeply-seated and inconspicuous." (*Sykes.*) The original figure is copied.

Unfortunately the type and only specimen is probably lost. I follow M. Ancey in referring the fossil material to this species. It agrees fairly well with the description, though many of the specimens with over 6 whorls measure only 6.2 mm. In Mr. Baldwin's collection is a shell which I have referred to this species. This shell is broader in proportion to its length, being nearly 3 mm. in diameter; in its other characters it agrees closely with Mr. Sykes' description.

O. *Group of L. striatula.*

91. L. ATTENUATA n. sp. Pl. 7, figs. 45, 46.

The shell is perforate, elongate, attenuate, brownish corneous, rather thin, subdiaphanous, glossy, rather closely costulate (except on the embryonic whorls) there being 4-6 costæ to a millimeter. Spire attenuate, apex subobtuse. Suture finely margined, lightly impressed, slightly crenulate. Whorls 8, very slightly convex, the penultimate slightly more tumid than the rest, the last elongate, somewhat attenuate at the base, slightly ascending near the lip. Aperture subovate, slightly diagonal and very slightly oblique. Columella nearly straight, with a thick, acute callus along its face; columellar fold oblique, strong. Outer lip regularly arcuate, distinctly thickened within; columellar margin adnate for nearly ½ its length, almost covering the perforation. Umbilicus minute, with angular margin. Length 13.5, diam. 5.2, length of aperture 5.0 mm.

Kauai: Haleieie, Makaweli, Waiakoali, Ekaula (Cooke); Hanalei (Lyman, Cooke).

This species has been referred to *L. acuminata* Gld., and

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to *L. striatula* Gld., by various authors. *L. acuminata* is smoother, more slender, with a longer and narrower aperture and a weaker columellar fold. *L. striatula* is smaller, with more pronounced costæ and a flatter base.

Specimens, from Makaweli, measure 12.0 x 4.5 mm. They differ in that the aperture is more diagonal, the suture is usually accompanied with a reddish line and the last whorl ascends more abruptly than in specimens from the type locality (Haleiele).

Specimens from Ekaula are more cylindrical in form and have an almost perpendicular aperture. Those from Hanalei measure 10.0 x 4.6 mm. The spire is more turrited and the aperture less diagonal.

Unlike most *Leptachatinas* this species has a tubular columella, which is almost straight. The young have a rather large, circular umbilicus.

92. L. BALTEATA Pease. Pl. 7, figs. 27, 28, 30, 31.

"The shell is elongate, turrited, imperforate, dextral, somewhat thin, longitudinally closely costulate; whorls 7, flatly convex, the last almost equal to ½ the length of the shell; suture impressed, subcrenulate; aperture subvertical, oval; columella arcuate; columellar fold callous, hardly prominent; lip thickened within; yellow, the last whorl encircled at the middle with a broad reddish brown band; spire reddish brown, yellow at the suture. Length 11.0, diam. 5.0 mm." (*Pse.*)

Kauai: Wahiawa (Baldwin); at 4000 ft. (Perkins); Puukapele, Halemanu (Cooke).

Leptachatina balteata PEASE, P. Z. S., 1869, p. 651 (*nom. sol.*); Journ. de Conchyl., 1870, p. 91.—CROSSE, Journ. de Conchyl., 1876, pl. iv, fig. 4.—SYKES, Fauna Haw., ii, 1900, p. 358.—*Achatinella* (*Leptachatina*) *balteata* PFR., Mon. Hel. Viv., viii, p. 248.

There are two color varieties of this species. The color variety, described by Pease (pl. 7, figs. 30, 31, copied from the original figures, and fig. 27) with a broad reddish brown band is rather uncommon; a unicolorous brownish corneous variety (fig. 28) is more abundant. Shells from Puukapele are

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slightly larger than those described by Pease. An average specimen measuring, length 11.3, diam. 5.3, length of aperture 4.6 mm. Those from Halemanu are smaller. A well developed specimen measuring, length 9.2, diam. 4.5, length of aperture 4.1 mm.

This species appears to be distantly related to *L. fusca* Newc., from Oahu. The embryonic whorls are slightly compressed and very slightly shouldered, though less so than in the latter species. In *L. balteata* the embryonic whorls are not strongly striate, but are almost smooth.

93. L. COSTULOSA Pease. Pl. 7, fig. 42; pl. 12, fig. 6.

"The shell is elongate, turrited, thin, imperforate, dextral, longitudinally closely costulate; whorls 8, somewhat flat, scarcely crenulate at the suture, the last almost equal to ⅓ of the length; aperture small, broadly elliptical, subvertical, angulate at the base of the columella; columellar fold small, oblique; columella erect, callous, white; lip scarcely thickened; yellow, often colored with purple at the suture. Length 14.0, diam. 5.0 mm." (*Pse.*)

Kauai (Pease): Waimea and Kealia (Baldwin).

Leptachatina costulosa PEASE, P. Z. S., 1869, p. 651 (*nom. sol.*); Journ. de Conchyl., 1870, p. 90.—CROSSE, Journ. de Conchyl., 1876, pl. 3, fig. 4.—*Achatinella* (*Leptachatina*) *costulosa* PFR., Mon. Hel. Viv., viii, p. 248.

"*L. striatula* Gould is the closest related species to this" (*Pse.*). I have seen but four specimens which might possibly be referred to this species. These were in Mr. Thaanum's collection and were collected by Mr. Baldwin. The species appears to be more closely allied to *L. tenebrosa* Pse., than to *L. striatula*. From the former it differs in being larger, with a broader spire, much lighter in color and with a slightly more diagonal aperture. It may ultimately prove to be a variety of this species. The original figure is copied on pl. 7.

94. L. EXTENSA Pease. Pl. 8, fig. 67.

"The shell is elongate, slender, imperforate, dextral, somewhat solid, glossy, longitudinally closely impressed striate;

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whorls 9, flatly convex, scarcely angulate and crenulate at the suture; suture impressed; spire somewhat obtuse; aperture small, short, oval, slightly oblique; columella short, simple; columellar fold compressed, scarcely prominent, oblique; lip scarcely thickened; the spire often ashy brown, the last whorl reddish brown. Length 11.0, diam. 4.0 mm." (*Pease*).

Kauai: Kaholuamano (Perkins); Lehuamakanoe, Kumuwela (Cooke).

Leptachatina extensa PEASE, P. Z. S., 1869, p. 651(*nom. sol.*); Journ. de Conchyl., 1870, p. 92.—SYKES, Fauna Haw., ii, 1900, p. 362.—*Achatinella* (*Leptachatina*) *extensa* PFR., Mon. Hel. Viv., viii, p. 249.

The shells from Lehuamakanoe are slightly larger and those from Kumuwela slightly smaller than the measurements given by Pease. The former measuring, length 12.5, diam. 4.5, length of aperture 4.0 mm.; the latter, length 10.1, diam. 3.6, length of aperture 3.4 mm.

This species differs from any of the other Kauaian species. Its chief characters are its closely coiled, almost flat whorls and the very fine and close striæ. The species seems to restricted to the higher altitudes.

95. L. GAYI n. sp. Pl. 7, figs. 39, 40.

The shell is perforate, ovately turrited, dark brown, thin, subdiaphanous, regularly, though somewhat distantly costate. Spire ovately turrited, apex obtuse. Suture scarcely impressed, not margined, crenulate. Whorls 7, nearly flat, rather compressed, the embryonic smooth, yellowish, the last cylindrical above, tapering towards the base. Aperture nearly ovate, slightly angled below, perpendicular, very slightly oblique. Columella straight, not truncate, with a very small, oblique and deeply situated fold and a slight acute callus along its face. Outer lip regularly curved, thickened within. Umbilicus large, (for the genus), nearly circular, with its margin angulate. Length 8.0, diam. 3.8, length of aperture 3.3 mm.

Kauai: Makaweli (Cooke).

This species is most closely related to *L. fusca* Newc. from

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Oahu and *L. fraterna* from Kauai. It differs from the former in having a much larger umbilicus, less convex whorls and the embryonic whorls are not striate.

In *L. fraterna* the umbilicus is smaller, the shell larger, the embryonic whorls costulate, etc.

96. L. LEUCOCHILA (Gulick). Pl. 7, figs. 33 to 38.

"Shell dextral, imperforate, ovately turrited, shining, semipellucid, corneous, with crowded longitudinal striæ; apex obtuse; spire turrited; suture finely margined, moderately impressed; whorls 7-8, somewhat convex; columellar fold sub-basal, white; aperture sinuately pyriform; peristome pallid, with slight callous thickening; dextral margin unreflected, arcuate; columellar margin dilated, white, adnate; parietal margin very thin, corneous. Length 11.0, diam. 4.8, length of body whorl 6.6 mm." (*Gul.*).

Kauai: Milolii, Waipo (Cooke).

Achatinella leucochila GULICK, Ann. Lyc. N. Y., vi, 1856, p. 173, pl. 6, fig. 1.—*Leptachatina leucochila* SYKES, P. Malac. Soc. London, iii, pl. 14, fig. 12; Fauna Haw., ii, Moll., p. 365. —*Achatinella pyramis* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 319.—*Achatinella* (*Leptachatina*) *pyramis* PFEIFFER, Mon. Hel. Viv., vi, p. 184.

This species is closely related to *L. balteata* Pse. The surface is, however, more glossy and the embryonic whorls are not as compressed as in Pease's species. In all the specimens referred to his species there is an additional columellar fold, which is more oblique and deeply situated than the usual fold. This fold is just above the latter, with which it forms a very acute angle. The additional fold is easily seen in specimens which have the columella exposed. This is the only species in which the duplication of the columellar fold has been observed.

The shells referred to this species agree closely with shells from Gulick, except that the costæ are slightly further apart and the additional columellar fold is more prominent.

One of Gulick's shells has the following measurements: length 11.4, diam. 5.3, length of aperture 5.1 mm.

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Fig. 35 is a copy of Mr. Sykes' figure of Gulick's type.

97. L. PUPOIDEA n. sp. Pl. 7, figs. 43, 44.

The shell is imperforate, elongate, subcylindrical, brownish corneous, glossy, rather thin, subdiaphanous, very closely costulate (except the embryonic whorls), with about 6-7 costæ to a millimeter. Spire narrowly ovate, apex subacute. Suture scarcely impressed, very narrowly margined, crenulate. Whorls 8, scarcely convex, the last subcyclindrical, with a somewhat tapering base. Aperture perpendicular, slightly oblique, narrowly ovate, acute at both ends. Columella nearly straight, with a rather strong, oblique fold and an acute callus along its face. Outer lip regularly curved, thickened within; columellar margin adnate; the margins united by a thin, transparent parietal callus, which is spirally striate. Length 11.4, diam. 4.5, length of aperture 4.6 mm.

Kauai: Milolii, at 1500 ft. (type loc.); and Halemanu, at 3500 ft. (Cooke).

This species is most closely related to *L. costulosa* Pse. It differs, however, in size and form; the apex and upper whorls are more attenuate, the shell is thinner and the surface more closely and finely costate. This species is rather abundant in the type locality.

98. L. STRIATULA (Gould). Pl. 12, figs. 4, 5.

"The shell is small, ovately elongate, glossy, greenish, finely and closely longitudinally striate-costate; whorls 7, convex, the last equal to one-half of the spire; aperture narrow, semilunate; lip whitish, thickened. Length 7/20, diam. 3/20 inch (8.75 x 3.75 mm.)." (*Gld.*)

Kauai: Makaweli, Kaholuamano, Lihue and at 4000 ft. (Perkins); Kipu and Kilohana (near Lihue) (Cooke).

Achatinella striatula GOULD, Proc. Bost. Soc. N. H., ii, 1845, p. 28.—*Leptachatina striatula* PEASE, P. Z. S. London, 1869, p. 651.—SYKES, Fauna Haw., ii, Moll., p. 370.—*Achatinella clara* PFEIFFER, P. Z. S. London, 1845 (Jan., 1846), p. 90; Mon. Hel. Viv., ii, p. 242.—REEVE, Conch. Icon., *Achatinella*, sp. 5.—*Achatinella* (*Leptachatina*) *clara* PFEIFFER, Mon. Hel. Viv., iv, p. 564.

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The bottle in which are the types of this species contains a varied assortment of different species, besides the one described above. A form, which comes nearest to the description, and agrees very closely with some of the shells included in the type lot, is from the district of Lihue. A few of them are nearly equal to Gould's measurements, the majority are slightly larger, and a very few equal or are slightly larger than Pfeiffer's (12.0 x 4.75 mm.). Small adult specimens from Kipu measure, length 9.2, diam. 4.1, length of ap. 3.2 mm.; the majority from this locality measure: length 10.0, diam. 4.2, length of ap. 3.5 mm.; a large specimen of this species has the following measurements: length 12.5, diam. 5.4, length of aperture 4.8 mm. Most of the shells have a dark reddish band at the suture.

This species and *L. leucochila* are very closely related. In the former the whorls are more closely coiled, the suture nearly transverse and scarcely oblique, the surface more closely costate, the last whorl is shorter, more tumid, with a flatter base, the aperture is shorter, broader in proportion to its length and the columella has a single fold.

Pl. 12, fig. 5 represents the synonymous *A. clara* Pfr.

99. L. TENEBROSA Pease. Pl. 7, figs. 25, 26, 29.

"The shell is imperforate, elongately turrited, solid, longitudinally costate; whorls 8, flatly convex, the last equal to ⅓ the length of the shell; suture simple, subimpressed; aperture small, oval, angulate at the base of the columella; columella callous, erect; columellar fold strong, scarcely prominent; lip thickened; blackish, or reddish brown, apex pale. Length 12.0, diam. 5.0 mm." (Pse.)

Kauai: Kaholuamano (Perkins), Halemanu, Puukapele, Kumuwela, Ekaula (Cooke).

Leptachatina tenebrosa PEASE, P. Z. S., 1869, p. 651 (*nom. sol.*); Journ. de Conchyl., xviii, p. 92.—CROSSE, Journ. de Conchyl., xxiii, 1876, pl. 3, fig. 5.—SYKES, Fauna Haw., ii, 1900, p. 371.—*Achatinella* (*Leptachatina*) *tenebrosa* PFR., Mon. Hel. Viv., viii, p. 248.

Shells from Puukapele are identical with those of this

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species in Pease's collection at Cambridge. A few have an additional whorl and measure 13.5 x 4.9 mm.

Specimens from Kumuwela are slightly more obese and for the most part lighter colored. One with 8 whorls measured 12.8 x 5.3 mm.

Those from Halemanu are somewhat smaller. A well developed shell with 8½ whorls measured: 11.0 x 4.5 mm.

A single shell from Ekaula is quite slender for this species; it has 9 whorls and measures 12.8 x 4.3 mm.

Subgenus LABIELLA Pfeiffer, 1854.

Labiella PFR., Malak. Blätter, 1854, p. 142; P. Z. S., 1855, p. 7.—HARTMAN, P. Ac. Phila., 1888, p. 41.—H. & A. ADAMS, Gen. Recent Moll., ii, p. 139.—GULICK, P. Z. S. London, 1873, p. 91.—PEASE, P. Z. S., 1869, p. 651.

Labiella was proposed by Pfeiffer as a section of *Achatinella* for *A. labiata*, with the following diagnosis "Shell oblong, solid; columellar fold twisted; lip obtuse, thickened, with a tooth-like callosity within the dextral margin."

Hartman followed Pfeiffer in considering *Labiella* as a section. H. and A. Adams raised *Labiella* to subgeneric rank. Gulick (1873) transfered *Labiella* to a section of *Leptachatina*. Pease raised *Labiella* to the rank of a full genus. He enumerated twelve species, four of which (*crassilabrum, ellipsoidea, albolabris* and *subrostrata*) belong to the genus *Amastra*.

There are but four species (three from Oahu and one from Maui) which can properly be included in this subgenus. The spire in these species is slightly concave in outline; the upper whorls are closely coiled and increase slowly; the denticle of the outer lip is present in three of the four species. This character is almost or entirely lacking in *lagena* but as this species is otherwise closely related to *labiata* it is best to include it in the same subgenus. The denticle was lacking in the type specimen of *lenta*, but there is a specimen in Mr. Baldwin's collection in which this character is clearly indicated.

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100. L. LABIATA Newcomb. Pl. 3, figs. 45, 49, 55.

"Shell dextral, elongate-ovoid, plumbeous except the third whorl, the margin of the outer lip, and along the suture of the last whorl, which are white; whorls 7, flattened; the third narrower than the second; suture slightly margined below; aperture elongate-ovate; columella short, with a strong, plaited projecting tooth; lip thickened, white, with a central internal callosity. Length 0.5, diam. 0.21 inch." (12.5 x 5.2 mm.) (*Newc.*)

Oahu: Lehui (Newcomb), Mt. Kaala (Baldwin), Palehua, Leilehua and Haleauau in the Waianae Mts. (Cooke).

Achatinella labiata NEWCOMB, Ann. Lyc. N. Y., vi, 1853, p. 27; P. Z. S. London, 1853 (1854), p. 141, pl. 23, fig. 33.—*Achatinella* (*Labiella*) *labiata* PFEIFFER, Mon. Hel. Viv., iv, p. 530; vi, p. 170; viii, p. 218.—*Labiella labiata* PEASE, P. Z. S. London, 1869, p. 651.—*Achatinella dentata* PFEIFFER, P. Z. S., London, 1855, p. 7, pl. 30, fig. 27.—*Achatinella* (*Labiella*) *dentata* PFR., Mon. Hel. Viv., iv, p. 530; vi, p. 170; viii, p. 218.—*Leptachatina* (*Labiella*) *labiata* SYKES, Fauna Haw., ii, Moll., p. 365.

Shells from Leilehua are quite large, of a uniform dingy straw-color, hardly shining, with a much thickened lip and having a costiform callus connecting the margins of the aperture. Those from Haleauau are very glossy, pinkish brown at the base, darker at the periphery, the spire and upper portion of the last whorl are almost white and the callosity of the outer lip is hardly developed. Those from Palehua have a dark plumbeous (sometimes with a reddish tinge) base, with the spire and upper portion of the last whorl of a rusty straw-color.

Specimens from the different localities have the following measurements:

Length 14.7, diam. 6.4, length of apert. 6.4 mm. Kaala (Baldwin coll.).

Length 13.9, diam. 6.5, length of apert. 6.5 mm. Leilehua.

Length 12.2, diam. 5.7, length of apert. 5.9 mm. Haleauau.

Length 12.6, diam. 6.0, length of apert. 5.9 mm. Palehua.

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Length 11.2, diam. 5.5, length of apert. 5.4 mm. Palehua.

Fig. 55 is copied from the original figure of *A. dentata* Pfr.; fig. 49 from the original of *labiata* Nc.

101. L. CALLOSA (Pfeiffer).

"Shell imperforate, dextral, fusiform-oblong, solid, lightly striate, white under the tawny epidermis; spire elongate, ventricosely conical, apex somewhat obtuse; suture slightly ragged; whorls 8, nearly flat, the last a little more than ⅓ of the length, attenuate at the base; columellar fold acutely dentiform, white; aperture scarcely oblique, acuminately elliptical; lip callous, obtuse, dextral margin obsoletely dentate within. Length 16, diam. 6 mm." (*Pfeiffer.*)

Oahu (Newcomb).

Achatinella (*Labiella*) *callosa* PFEIFFER, P. Z. S. London, 1856, p. 334; Mon. Hel. Viv., iv, p. 531; vi, p. 170; viii, p. 218.—*Labiella callosa* PSE., P. Z. S. London, 1869, p. 651.—*Leptachatina* (*Labiella*) *callosa* SYKES, Fauna Haw., ii, 1900, p. 358.

This species is represented, as far as I know, by the single type specimen in the British Museum. It is very closely related to *L. labiata* Newc., and may ultimately prove to be an unique specimen of this species. The spires of both species are identical. The only differences are that *L. callosa* is larger and has a different shaped aperture.

102. L. LAGENA (Gulick). Pl. 5, figs. 83, 84, 89.

"Shell dextral, imperforate, acuminately ovate, rather solid, dark resinous, very finely striated; apex somewhat obtuse, pallid; spire concavely conical; suture simple, slightly impressed; whorls 7, rather convex; columellar fold central, white, strongly lamelliform; aperture truncately auriform; peristome somewhat labiate, white or reddish; dextral margin unreflected, arcuate; columellar margin dilated, white, adnate; parietal margin thin, dark corneous. Length 13.0, diam. 6.6, length of body whorl 9.0 mm." (*Gulick.*)

"Var. *b*. Small, length 10.0, diam. 5.3, length of body whorl 7.3 mm." (*Gulick.*)

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"Var. *c*. Light corneous, thinner, with lip but slightly thickened." (*Gulick.*)

Oahu: Halemanu, Waihiawa, Kalaikoa (Gulick); Waianae Mts. back of Leilehua (Cooke).

Achatinella lagena GULICK, Ann. Lyc. N. Y., vi, 1856, p. 175, pl. 6, fig. 3.—*Achatinella labiata* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 328.—*Achatinella* (*Leptachatina*) *fumosa* NEWC., var. ? *lagena* PFR., Mon. Hel. Viv., vi, p. 182.—*Leptachatina lagena* SYKES, P. Malac. Soc. London, iii, 1899, pl. 14, fig. 9.—*Leptachatina* (*Labiella*) *labiata* SYKES, Fauna Haw., ii, 1900, p. 365.

L. lagena approaches *L. labiata* in form; the spires of both species are similar, but the apertures are entirely distinct. In the former there is no callosity within the outer margin of the lip, which is regularly arcuate and not flattened as in the latter species. *L. lagena* is also thinner, and dark resinous in color. This species was considered by Newcomb to be an undeveloped *L. labiata*; but fully adult specimens are easily distinguished from the young of the latter species. Figs. 83, 84 represent a specimen received from Mr. Gulick.

103. L. LENTA n. sp. Pl. 2, figs. 23, 24.

The shell is imperforate, elongately conic, the embryonic whorls whitish, the rest brown, with a faint reddish line accompanying the suture, under a lens faintly and irregularly striate with lines of growth. Spire elongately conic, apex rounded. Suture hardly impressed, faintly margined, minutely crenulate. Whorls 6½, nearly flat, regularly increasing, the last subcylindrical, tapering to the base. Aperture narrow, acute at both ends, oblique, perpendicular. Columella nearly straight, with a rather strong oblique fold, and an acute callus along its face. Outer lip arcuate, strongly thickened within, whitish; columellar margin reflexed, adnate. Length 8.4, diam. 3.7, length of ap. 3.7 mm.

West Maui: Maunahoomaha (Cooke), Wahakuli (Baldwin).

A rather interesting species, which seems to be related to *L. labiata* Newc., from Oahu. It is much smaller than the

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other species belonging to this section, and, in the type specimen, the denticle on the outer lip is lacking. Unlike anything from Maui, except possibly *L. compacta,* Pse., from which it differs in its more elongate spire and narrower and more perpendicular aperture.

A single shell, in Mr. Baldwin's collection, undoubtedly belongs to this species. It is larger than the type specimen, measuring 11.7 x 5.3 mm., and is of a yellowish straw color. The denticle on the outer lip is faintly indicated, though not as pronounced as in specimens of *L. labiata.*

Subgenus PAUAHIA n. subgenus.

The shells are imperforate or minutely perforate, cylindrical, striate, rather thin; the embryonic whorls are smooth, rounded; the whorls are closely coiled and increase very slowly and regularly; the columellar fold is rather weak at the aperture but becomes stronger within the shell. In young shells there is a rather strong palatal lamina beginning underneath the junction of the lip and extending under the periphery nearly to the margin of the aperture. Type *L. artata.*

This subgenus is proposed for three species: *artata, tantilla* and *chrysallis,* all from Oahu. In the first two the rather strong palatal lamina is clearly seen in young specimens, and in the case of *artata* is faintly indicated in adult specimens. Unfortunately I have not seen any young specimens of *chrysallis,* so for the present it is not known whether this species has this character. There is no doubt that *chrysallis* belongs to this subgenus as it agrees closely in its other subgeneric characters.

Pauahia is dedicated to Bernice Pauahi Bishop, in whose memory the museum at Honolulu which bears her name was founded.

104. L. ARTATA n. sp. Pl. 13, figs. 1, 2, 3, 4.

The shell is imperforate, subcylindrical to subovate, nearly corneous, thin, subdiaphanous, glossy, under a lens minutely and regularly striate with lines of growth. Spire subcylin-

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drical for the last three whorls, the upper 5½ somewhat convex, apex minute, blunt. Suture simple, hardly impressed. Whorls 8½, the lower of the nepionic rather broader than the early neanic, the latter flat, increasing very slowly in size, the last two whorls nearly equal, very slightly convex, the last nearly cylindrical, tapering towards the base. Aperture narrowly pyriform, slightly oblique, acute and narrow above, somewhat angulate at the columella, nearly perpendicular, not diagonal. Columella nearly perpendicular, truncate, with a rather small oblique fold which becomes stronger about one whorl within. Outer lip erect, very slightly thickened within, nearly straight; columellar margin whitish, thin, appressed. A thin whitish callus unites both margins. Length 7.2, diam. 3.2; length of ap. 3 mm.

Oahu: Halawa, 1,500 ft. (Cooke); Mt. Tantalus 2,000 ft. (Lyman).

The form from Tantalus is smaller, smoother, with a yellowish corneous color. This species is most closely allied to *L. chrysallis* Pfr. The latter is, however, much larger, more cylindrical in outline, with a stronger sculptured surface and the aperture is much broader and more ovate.

105. L. TANTILLA n. sp. Pl. 13, figs. 5, 6, 7.

The shell is minutely perforate, narrowly subcylindrical, corneous, somewhat glossy, finely striate, with uneven striæ, somewhat wrinkled and more prominent near the suture. Spire subcylindrical, gradually tapering towards the apex, which is rather blunt. Suture simple, hardly impressed. Whorls 7½, nearly flat, slowly and regularly increasing in size, the last nearly cylindrical, tapering towards the base. Aperture pyriform, slightly oblique, perpendicular. Columella nearly straight, scarcely truncate, with a very minute oblique fold. Outer margin of lip erect, straight, arcuate below, slightly thickened within; columellar margin slightly thickened, reflexed, free. Umbilicus minute, nearly circular. Length 5.4, diam. 2.4; length of aperture 2.2 mm.

Oahu: Waianae Mts. back of Leilehua (Cooke).

This species is closely related to *L. artata*. It differs, how-

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ever, in being smaller, the surface is more distinctly sculptured, the aperture is broader in proportion to its length and there is a distinct, though minute, perforation.

✓106. L. CHRYSALLIS (Pfeiffer). Pl. 4, figs. 77, 78.

"Shell oblong turrited, somewhat solid, slightly striate, arcuately plicate at the sutural line, pale yellowish; spire subcylindrical, apex conic, obtuse; whorls 10, nearly flat, the last nearly equal to ⅓ of the length, rotundate at the base; columella callous, abruptly truncate at the base; aperture vertical, sinuately semioval; lip erect, with the dextral margin arcuate, thickened within. Length 9.0, diam. 3.5 mm." (Pfr.)

Oahu: Waialua (Baldwin, Lyman), Waianae Mts. and Wahiawa (Cooke).

Achatina chrysallis PFEIFFER, P. Z. S. London, 1855, p. 99; Mon. Hel. Viv., iv, p. 617; vi, p. 238.—*Achatina* (*Electra*) *chrysallis* PFR., Malak. Blätter, 1856, p. 169. — *Leptachatina chrysallis* PEASE, P. Z. S., 1860, p. 650.—*Leptachatina columna* ANCEY, Le Naturaliste, 1889, p. 266.—SYKES, Proc. Malac. Soc. London, iii, pl. 13, fig. 18.—*Leptachatina chrysallis* SYKES, Fauna Haw., ii, 1900, p. 358.

This species is never abundant in any one locality, but seems to be distributed over a rather large area. A single specimen from Nuuanu is referable to this species, though doubtfully. I have examined both Ancey's and Pfeiffer's types and there is no doubt that both belong to the same species.

Unfortunately I have no young specimens of this species, the basal palatal lamella does not appear in adult specimens.

Subgenus THAANUMIA Ancey, 1899.

Thaanumia ANCEY, Proceedings of the Malacological Society of London, iii, July, 1899, p. 269, monotype *T. omphalodes*.

The shells are openly umbilicate or perforate, sometimes imperforate, hardly glossy, of a silky texture, thin or somewhat solid, costulate to costate, with the embryonic whorls

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encircled by very minute, close, raised, spiral lines; the suture of the embryonic whorls is rather wide and deep and these whorls are somewhat flattened and very slightly shouldered above. Type *L. omphalodes*.

Thaanumia can hardly be ranked as a genus, since except for the minutely striate embryonic whorls, all the species could undoubtedly be placed in *Leptachatina*. There are at present eight species known.

L. (Thaanumia) omphalodes Ancey, Oahu.
L. (Thaanumia) optabilis n. sp., Oahu.
L. (Thaanumia) morbida n. sp., Molokai.
L. (Thaanumia) thaanumi n. sp., Molokai.
L. (Thaanumia) henshawi Sykes, Hawaii.
L. (Thaanumia) perforata n. sp., Kauai.
L. (Thaanumia) dulcis n. sp., East Maui.

All the species are from rather open and dry localities and are not found in the deep woods. The characters of the embryonic whorls are not easily seen, and in most cases are only made out under a compound microscope. They are best seen in rather young fresh specimens.

107. L. OMPHALODES (Ancey). Pl. 13, fig. 11.

"The shell is openly umbilicate, ovately conic, glossy, with a silky luster, acutely and irregularly longitudinally costulate with somewhat lamellate, slightly flexuous costæ, dark reddish corneous, pale purple at the lip. Spire regularly conic, rectilinear in outline, subobtuse at the apex. Whorls 6, convex, regularly increasing, separated by an impressed suture, the embryonic very minutely spirally sculptured, the rest costulate, irregularly striatulate in the interstices, the last at first subangulate, ovate, dilated, at the end minutely and shortly ascending, angulate and compressed about the umbilicus. Aperture perpendicular, receding at the base, irregularly oval, contracted at both ends. Columella perpendicularly descending, long, joined to the base with an obtuse angle, at its base lightly twisted-plicate within. Lip slightly expanded on all sides, expanded at the columella more, with the margins not contracted. Length 6.3, diam. 3.5, length of ap. 2.6 mm." (*Ancey.*)

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Oahu: Waianae Mts. (Baldwin).

Thaanumia omphalodes ANCEY, Proc. Malac. Soc. London, iii, 1899, p. 269, pl. 12, fig. 8.

This species is the type of the subgenus *Thaanumia.*

The comparatively large and open umbilicus easily separates this from the other species of the subgenus.

108. L. OPTABILIS n. sp. Pl. 13, fig. 9.

The shell is minutely but distinctly perforate, ovate, light corneous with a broad brown band above the periphery, rather thin, silky, minutely and closely striate, with more distinct striæ on the neanic whorls and just below the suture of the last whorl, under a very strong lens the embryonic whorls are indistinctly spirally striate. Spire almost conic with slightly convex outlines, apex rather blunt. Suture impressed, not margined, rather deep and very distinct on the embryonic whorls. Whorls 5½, the embryonic indistinctly shouldered, the rest slightly convex, the last subcylindrical, tapering towards the base. Aperture ovately pyriform, hardly oblique, very slightly diagonal. Columella slightly oblique, narrowly triangular, with a rather strong sub-basal fold. Outer lip regularly curved, convex, slightly thickened, columellar margin thin, adnate above, reflexed over the minute umbilicus. Umbilicus minute. Length 6.8, diam. 3.6 mm. Length of ap. 3.3 mm. (Cooke).

Oahu: Waianae Mts., back of Leilehua (Cooke).

There is a unicolorous light brown variety of this species from the same locality. This species was found in rather open and dry country. The spirally striate embryonic whorls and the presence of a perforation places this species in the subgenus *Thaanumia.* It differs from *L. omphalodes* Anc. in having a less open umbilicus and the surface is not as distinctly costate. The peculiar silky luster is present in both species.

109. L. FUSCULA (Gulick). Pl. 3, fig. 51.

"Shell dextral, imperforate, ovate conic, thin, with but little polish, of a brown succineous color, and very finely

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striated; apex subacute; spire convexly conical; suture simple, lightly impressed; whorls 6, somewhat convex; columella a little oblique, white and plicately truncated; aperture truncately oval; peristome simple with dextral margin unreflected, acute, arcuate; columellar margin dilated, thin, white. Length 8.3, diam. 4.3, length of body whorl 5.3 mm." (Gulick.)

Oahu: Mokuleia (Gulick); Palolo (Gulick, vid. label in Bost. Soc.); Waianae Mts., back of Waialua (Lyman); Waianae Mts., back of Leilehua (Cooke).

Achatinella fuscula GULICK, Ann. Lyc. N. Y., vi, 1856, p. 180, pl. 6, fig. 8. — *Achatinella* (*Leptachatina*) *fuscula* PFEIFFER, Mon. Hel. Viv., vi, p. 183; viii, p. 245.—*Leptachatina fuscula* PSE., P. Z. S. London, 1869, p. 651.—SYKES, Fauna Haw., ii, 1900, p. 362.

This species appears to be represented by a single shell, in the collection of the Boston Society of Natural History. Unfortunately the specimen was dead when collected. The shells collected by Mr. Lyman and myself agree very closely with the type, except that a few are minutely perforate and all are slightly larger. The type specimen has Palolo as its habitat. I am sure that this must be a mistake, as all the species that are in any way related to it are from the other end of Oahu. Gulick gave the length of the body whorl as 4.3 mm., but if we reduce his measurement in inches to millimeters it should be 5.3 mm.

L. fuscula is provisionally located in the subgenus *Thaanumia*. A few of the specimens collected by Mr. Lyman and myself are minutely perforate, and a number show the faint spiral striæ on the embryonic whorls, which are less flattened and have a shallower suture than most of the species included in this subgenus. The costæ are also less prominent.

In fresh dark-colored specimens the columella and lip, especially the former, are a purplish brown. There is also a lighter colored, almost corneous, variety.

110. L. DULCIS n. sp. Pl. 13, figs. 8, 10.

The shell is perforate, ovately conic, light brown, with a

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yellowish sheen, silky, thin, the embryonic whorls with minute spiral striæ, the rest closely and regularly costate. Spire conic, apex obtuse. Suture simple, impressed. Whorls 5½, increasing regularly, the embryonic flattened, compressed, shouldered above, the rest somewhat convex, the last rather large, tapering gradually to the base. Aperture rather large, ovate, hardly oblique and slightly diagonal, brownish within. Columella narrowly triangular, nearly perpendicular, brownish, with a minute, oblique basal fold. Outer lip regularly curved, convex, indistinctly angulate with the base of the columella; columellar margin thin, adnate above, reflexed over the perforation. Umbilicus rather small, subcircular. Length 7.0, diam. 3.7, length of ap. 3.4 mm.

East Maui: Ulapalakua, Makawao (Baldwin).

The only representative of this subgenus from Maui. It resembles the species from Oahu and Hawaii rather than those from the nearer island of Molokai. This species has a smaller umbilicus than *L. omphalodes* Ancey and it is more distinctly costate than *L. optabilis*.

111. L. HENSHAWI Sykes. Pl. 1, figs. 15, 17.

"Shell ovately pyramidal, rimate, somewhat thin, brownish-horny in color, longitudinally well marked with filiform striæ, which become weaker towards the base, apex blunt. Whorls 5½, plano-convex, the protoconch being large and smooth, the others sculptured as mentioned above, the last whorl measuring 4/7 of the entire length of the shell. Suture well marked. Mouth subquadrate, the straight columellar margin being slightly reflected. Plica small and ascending. Length 7.0, diam. 3.6 mm." (*Sykes.*)

Hawaii: (Bucholtz); Kona, at 1800 feet (Henshaw), Mana fossil (Henshaw), Waimea Plains, near Mana (Thaanum), Hamakua and Kona (Baldwin).

Leptachatina henshawi SYKES, Journ. of Malac., x, 1903, p. 2, fig. in text.

"This pretty little shell recalls somewhat in appearance *Thaanumia omphalodes* Ancey, but lacks the sculpture of the protoconch and the distinct umbilical area. The sculp-

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ture is similar in nature to that of *L. tenebrosa* Pease, of Kauai, etc." (*Sykes.*)

L. tenuicostata Pease, is somewhat closely related to this species. The latter is, however perforate; the outlines of the spire and the whorls are more convex; the columellar fold is stronger and approaches the outer face of the columella, etc.

Mr. Thaanum kindly lent me a few specimens of this species from the original lot collected by Dr. Henshaw. All the specimens had the characteristic blunt apex; in a few the spiral lines of the embryonic whorls were made out with a strong lens.

112. L. MORBIDA n. sp. Pl. 13, fig. 12.

The shell is minutely perforate (sometimes imperforate), conic, dark brown, hardly glossy, rather solid, not diaphanous, distinctly costate (especially on the neanic whorls), the embryonic whorls smooth. Spire conic, apex somewhat obtuse. Suture very slightly impressed, crenulate. Whorls 6, regularly increasing, the embryonic flattened, slightly shouldered above, with a rather distinct suture, the rest slightly convex, the last rotundate, tapering to the base. Aperture large, ovate, purplish brown within, hardly oblique, slightly diagonal. Columella nearly straight, with a thick acute callus along its face; columellar fold median, small, blunt. Outer lip regularly convex, thickened within, white; columellar margin slightly thickened, reflexed, adnate above. Umbilicus minute, oval. Length 9.0, diam. 4.7, length of ap. 4.0 mm.

Molokai: Puu Kolekole, under logs in open country (Thaanum).

This species is provisionally placed in the subgenus *Thaanumia*. It differs from the other species of this subgenus, by not having spirally striate embryonic whorls. These are, however, slightly flattened, compressed and have the rather distinct suture characteristic of this subgenus.

The nearest relative to this species, from Molokai, is *L.* (*Thaanumia*) *Thaanumi*. The latter is, however, smaller,

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narrower and with slightly more convex outlines. *L. semipicta*, from Lanai, is probably related to this species. The latter is slightly larger, more solid and more distinctly costate.

113. L. THAANUMI n. sp. Pl. 6, figs. 16, 17.

The shell is imperforate, conically ovate, yellowish corneous, with a broad reddish brown band at the periphery, thin, subdiaphanous, the embryonic whorls glossy, under a strong lens very faintly spirally striate, the rest finely and closely costulate. Spire subconic, apex obtuse. Suture hardly impressed, faintly margined, crenulate. Whorls barely 6, the first two convex, the rest nearly flat, the last rotundate, slightly tapering towards the base. Aperture broadly ovate, oblique, nearly perpendicular. Columella nearly straight, slightly twisted, with an almost obsolete oblique fold. Outer margin of lip arcuate, slightly thickened within, columellar margin thin, reflexed, adnate. Length 7.7, diam. 3.8, length of ap. 3.4 mm.

Molokai: Mapulehu ridge (Thaanum).

L. thaanumi is provisionally located in the subgenus *Thaanumia* as the embryonic whorls have the faint spiral sculpture on which the separation of the subgenus is almost wholly dependent. This species is, however, imperforate, which character is not found in any other species referred to this subgenus. It is also narower in proportion to its length than any species of this subgenus, except *L. perforata.*

114. L. PERFORATA n. sp. Pl. 7, fig. 32.

The shell is perforate, elongate, attenuate, brown or very dark brown, rather thin, not diaphanous, under a strong lens the embryonic whorls are very minutely spirally striate, the rest costate. Costæ arcuate, regular, 4.6 to the millimeter, with 45-50 on the last whorl. Spire attenuate, elongate, apex somewhat acute. Suture not margined, impressed. Whorls 9, slightly convex, the last rotundate, tapering towards the base. Aperture perpendicular, slightly oblique, shaped like an oblique sector of a circle, acute at both

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ends. Columella straight, white, hardly truncate, furnished with a minute, oblique, deeply situated fold. Outer and lower margin of lip regularly curved, slightly thickened within, columellar margin slightly thickened. Umbilicus rimate, with angular margin. Length 7.8, diam. 3.1, length of aperture 2.7 mm.

Kauai: Puukapele, 3000 ft.; Waipo, 3500 ft.; Kumuwela, 3800 ft. (Cooke).

This species is unlike any other from Kauai. The type locality is Puukapele. It is not abundant in any one locality, but is probably to be found over all the higher parts of the Island of Kauai.

L. perforata is provisionally located in *Thaanumia*, as its embryonic whorls are minutely spirally striate in fresh young specimens. It seems to be an aberrant form. It is possible that *L. striata* Newc. may be a relative of this species.

Subgenus ILIKALA n. subgenus.

The shells are perforate or minutely perforate, elongate with slightly convex outlines, costate; embryonic whorls convex, longitudinally costulate, separated by a rather deep and broad suture; columellar fold rather weak, subtransverse. Type *L. fusca* Newc.

This subgenus is proposed for three species: *fusca, petila* and *fraterna*; the first two from Oahu, the last from Kauai. The most important character on which this subgenus is based is the longitudinally costate or distinctly striate embryonic shell. *Ilikala* is probably related to *Thaanumia*, but the latter has smoother embryonic whorls which are minutely striate spirally, and not axially costulate. (*Ilikala*, an Hawaiian word meaning a rough skin.)

115. L. FUSCA (Newcomb). Pl. 4, figs. 65 to 69.

"Shell thin, cylindrically elongate; whorls 5, nearly flat; suture linear, slightly impressed; aperture ovate; lip acute; columella dentate within; longitudinal striæ strongly developed; color brown, with a narrow horn-colored band revolving below each suture; lower half of the last whorl horn-

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colored. Long. 6/20, diam. 3½/20 poll." (7.5 x 4.4 mm.) (*Newc.*) Length .35, diam. 0.2 inch (*Newc.*)

Oahu: Manoa (Newcomb, Cooke); Palolo, Mt. Tantalus, Pauoa, Konahuanui and Nuuanu (Cooke).

Achatinella fusca NEWCOMB, Ann. Lyc. N. Y., vi, 1853, p. 28; P. Z. S. 1853 (1854), p. 145, pl. 23, fig. 44.—*Achatinella* (*Laminella*) *fusca* PFEIFFER, Mon. Hel. Viv., iv, p. 558; vi, p. 181; viii, p. 244.—*Leptachatina fusca* PEASE, P. Z. S. London, 1869, p. 651.

This is one of the most aberrant species of the genus. The first whorl is slightly depressed, with a deep broad suture separating it from the second whorl which is rather convex and somewhat shouldered above. Both the first and second whorls are sculptured with rather strong longitudinal striæ and very fine spiral striæ. The latter are clearly visible under a strong lens, especially in young specimens. This is, also, one of the subgeneric characters of *Thaanumia*. The adult shells of *fusca* are always imperforate and the lower whorl is more drawn out and tapering. In young specimens of 5 or less whorls there is a minute perforation.

There are four distinct color varieties of the typical form of this species: the first and most abundant, which is also the one described by Newcomb, has a dark reddish brown band (which sometimes extends to the suture) above the periphery, the spire is reddish brown, there is usually a yellowish corneous band accompanying the suture and the base below the periphery is yellowish corneous (figs. 65, 66). The second is of a uniform dark reddish brown; the third is light brownish corneous, slightly lighter in color below the periphery (fig. 67). The fourth has the first 3½ whorls of a dark reddish brown, the two last are yellowish corneous, with a narrow reddish brown band accompanying the suture (fig. 69). The last two varieties are very rare as I have seen only two specimens of the third variety, which came from Nuuanu, and a single specimen of the fourth variety was collected in Palolo.

Adult shells vary between the following measurements:

Length 8.1, diam. 4.2, length of apert. 3.9 mm.; whorls 5½; Nuuanu.

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Length 8.9, diam. 4.4, length of apert. 4.3 mm.; whorls 5½; Konahuanui.

Length 10.5, diam. 4.5, length of apert. 4.5 mm.; whorls 6¼; Nuuanu.

115*a*. *L. f. striatella* (Gulick). Pl. 4, figs. 70, 71, 72.

The shell is very slightly narrower in proportion to its length, the costæ are slightly finer and the aperture is more perpendicular, with the outer lip less arcuate.

Length 10.0, diam. 4.4, length of apert. 4.2 mm.

Oahu: Mountain range of Keawaawa, in damp places (Gulick).

Achatinella striatella GULICK, Ann. Lyc. N. Y., 1856, vi, p. 178, pl. 6, fig. 6.—*Achatinella fusca* NEWCOMB, Ann. Lyc. N. Y., 1838, vi, p. 330.—*Leptachatina striatella* SYKES, P. Malac. Soc. London, iii, pl. 14, fig. 190; Fauna Haw., ii, 1900, p. 370.

116. L. FRATERNA n. sp. Pl. 12, figs. 8, 11.

The shell is minutely perforate, elongately conic, dark brown, rather thin, costulate (the embryonic whorls transversely costulate and under a strong lens indistinctly spirally striate). Spire conic, apex rather blunt. Suture deep on the embryonic whorls, on the other whorls hardly impressed. Whorls 6½, very slightly convex, increasing regularly, the last subcylindrical, tapering gradually to the base and ascending slightly in front. Aperture subovate, bordered with yellowish brown, brown within, very slightly oblique, perpendicular. Columella nearly straight, whitish, almost truncate with a rather weak fold and with an acute callus along its face. Outer lip regularly curved, slightly thickened within, forming an angle with the base of the columella; columellar margin thin, reflected, the upper one-third adnate. Umbilicus minute. Length 9.4, diam. 4.3, length of ap. 4.1 mm.

Kauai (Baldwin).

This species is very closely related to *L. fusca* Newc., from Oahu. It differs, however, in having flatter whorls and a more conic spire; the aperture is less diagonal.

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117. L. PETILA (Gulick). Pl. 4, figs. 61 to 64.

"Shell dextral, perforate, turreted, rather thin, not polished, brown, corneous, obliquely striated; apex somewhat obtuse, pallid; spire turreted; suture simple, well impressed; whorls 6, convex; columella vertical, brown, lightly plaited deep within the aperture; aperture vertical, subelliptical; peristome simple, with margins joining in an unbroken curve; dextral margin unreflected, arcuate; columellar margin slightly reflected, not appressed; parietal margin narrow, callous. Length 6.6, diam. 2.8, length of body whorl 3.5 mm." (*Gulick.*)

Oahu: Koko, under stones in dry rock regions (Gulick); Wailua (Lyman); fossil at Nuuanu, Manoa, and at Rocky Hill (Cooke).

Achatinella petila GULICK, Ann. Lyc. N. Y., vi, 1856, p. 189, pl. 6, fig. 17.—*Achatinella fusca* NEWCOMB, Ann. Lyc. N. Y., vi, 1858, p. 330.—*Achatinella* (*Laminella*) *fusca* PFR., Mon. Hel. Viv., vi, p. 181.—*Leptachatina petila* SYKES, P. Malac. Soc. London, iii, 1899, pl. 14, fig. 14; Fauna Haw., ii, 1900, p. 367.

Newcomb, Pfeiffer and Pease seem to have considered this species as identical with *L. fusca* Newc. It is, however, entirely distinct. The specimens collected by Gulick were from Koko Head, a very dry and almost desert region. All my specimens, except the fossil material, was found in the very darkest and dampest valleys of Nuuanu.

The fossil material from Rocky Hill agrees best with Gulick's specimens in the collection of the Boston Society. The shells from Nuuanu are imperforate. All my shells are considerably larger than Gulick's. The measurements are as follows:

Length 8.6, diam. 3.6, length of apert. 3.1 mm. Waialua.
Length 7.8, diam. 3.2, length of apert. 2.8 mm. Nuuanu.
Length 7.9, diam. 2.8, length of apert. 2.6 mm. Rocky Hill.

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Genus FERNANDEZIA Pilsbry, n. gen.

Shell imperforate, varying from ovate to oblong-turrite, thin, yellow or pale brown, glossy, striate or weakly plicate. Initial 1½ to 1¾ whorls smooth or very delicately striate spirally, semiglobose, forming an obtuse summit. Aperture irregularly ovate, subvertical, the outer lip a little thickened, having a smooth finish when adult; the columella short, bearing a more or less prominent, spirally entering fold or lamella. Soft anatomy unknown. Type: *F. wilsoni.*

Distribution: Island of Juan Fernandez. The species are figured on plate 14.

These shells resemble species of *Glessula* and *Leptachatina* so closely that only their geographic remoteness gives reason for the belief that they will prove generically distinct, when the soft parts can be examined. Like the genera mentioned, the lip has a smooth, blunt finish in fully adult shells; thereby differing from *Subulina*, *Opeas* and *Leptinaria*, which have the lip sharp and unthickened at all stages of growth. It must be admitted that the shells, in *Glessula*, *Leptachatina*, *Fernandezia* and *Cochlicopa* furnish no tangible character to differentiate one from another genus. What real distinction there may be in the animals remains to be discovered. Whether reproduction in *Fernandezia* is oviparous or viviparous is not known.

In some forms I have seen excessively superficial and fine spiral striæ upon both embryonic and later whorls; in others they are not discernible, at least in adult shells.

Key to species of Fernandezia.

I. Columella very short, with a strong median spirally entering lamella.

a 10½ x 6.2 mm. with 6⅓ whorls; periphery weakly subangular. *expansa*, no. 3.

*a*¹ 9 x 4.8 mm. with 6¾ whorls; subplicate below suture, the last whorl rounded *philippiana*, no. 4.

*a*² 10½ x 5.8 mm. with 7½ whorls; finely striate. *wilsoni*, no. 5.

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II. Columella longer, the fold weaker and nearer the base.

a Length of aperture more than half that of the shell; 11 x 6 mm., aperture 6 mm., with 5 to 6 whorls.
bulimoides, no. 1.
consimilis, no. 2.

*a*¹ Aperture less than half as long as the shell.

b 12 x 5½, aperture 5 mm., whorls 8; columella deeply twisted. *conifera*, no. 8.

*b*¹ 9.9 x 4, aperture 4 mm., whorls 7½; columella straight above, weakly folded below.
longa, no. 10.

*b*² 7 x 3 mm.; columellar fold strong.
splendida, no. 9.

*b*³ 6.6 x 3, aperture 3 mm., whorls 6, striate, columellar fold small. *tryoni*, no. 6.

*b*⁴ 9 x 4¼, aperture 4 mm., whorls 6¾, weakly plicate below suture. *inornata*, no. 7.

1. F. BULIMOIDES (Pfeiffer). Pl. 14, fig. 4.

"Shell ovate-conic, thin, striatulate, covered with a pellucid corneous-buff epidermis. Spire conic, acute; whorls 5½, scarcely convex, the last more swollen, as long as the spire. Columella twisted above, thread-like, very obsoletely truncated above the base of the broad, semioval aperture, provided with a thin callus covering the ventral part of the preceding whorl. Peristome simple, thin. Length 11, diam. 6, aperture 6 x 3.5 mm." (*Pfr.*).

Juan Fernandez (Cuming; Challenger Exped.).

Achatina bulimoides PFR., P. Z. S. 1846, p. 116 (Jan. 26, 1847); Monogr. ii, 271.—REEVE, Conch. Icon. v, pl. 19, f. 103 (June, 1849).—*Spiraxis b.*, PFR. Monogr. iii, 472; vi, 193.—*Stenogyra* (*Nothus*) *b.*, E. A. Smith, P. Z. S. 1884, p. 280 (Juan Fernandez, "Challenger" Exped.).

2. F. CONSIMILIS (Reeve). Pl. 14, fig. 11.

"Shell conically ovate, rather ventricose, whorls 5 to 6, rather flatly convex, finely striated, shining, columella short,

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straight, rather callous; yellowish-olive, transparent" (*Reeve*).

"Shell ovate-conic, thin, smooth, pellucid, glossy, buff-olivaceous; spire convexly-conic, acute; whorls 5, a little convex, the last longer than the spire, more convex. Columella straightened, callous, highly and shortly twisted-truncate. Aperture little oblique, oval; peristome simple, unexpanded. Length 11, diam. 6, aperture 6 x 3½ mm." (*Pfr.*)

Juan Fernandez (Miller, Cuming coll.)

Achatina consimilis REEVE, Conch. Icon. v, pl. 19, f. 104 (June, 1849).—*Spiraxis c.*, PFR., Monogr. iii, 471; iv, 574; vi, 192.—*Stenogyra* (*Euspiraxis*) *c.*, PFR., Nomencl. Hel. Viv. 1878, p. 324.

"Very similar in general aspect to the preceding species [*bulimoides*], but clearly distinct. It is less ventricose and the columella is nearly straight" (*Reeve*).

3. F. EXPANSA n. sp. Pl. 14, fig. 1.

The shell is imperforate, conic, thin, somewhat translucent, very glossy, covered with a pale yellow cuticle. Spire straightly conic, the apex obtuse, rounded; whorls 6⅓, slightly convex, the last very obtusely subangular in the middle, the base tapering and not very convex. The first two whorls are convex and indistinctly, very minutely marked with spiral lines; following whorls are irregularly, finely striate over a very weak plication, which is hardly noticeable except for a short distance below the suture. The aperture is trapezoidal. Columella very short, bearing a very strong, spirally entering, median lamella. Length 10.5, diam. 6.2 mm.; length of aperture 6 mm.

Juan Fernandez (A. N. S. P. no. 10164).

This form resembles *F. bulimoides* and *consimilis* in general shape, but differs by the very strong median columellar lamella and the subangular periphery. Neither of the specimens is quite fully adult, the outer lip being sharp, without the usual smooth finish.

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4. F. PHILIPPIANA n. sp. Pl. 14, figs. 2, 3.

The shell is imperforate, ovate-conic, thin, glossy, sufficiently transparent to show the columellar axis faintly through the shell, pale yellow. The spire is straightly conic with an obtuse, rounded apex. Whorls 6¾, but slightly convex. The first 1½ whorls are smooth, the first one wide, the next decidedly narrower; near the end of the second whorl fine vertical striæ appear. The remaining whorls of the spire are weakly plicate, the folds moderately strong near the suture, weakening rapidly and disappearing downward, and on the last whorl nearly or quite obsolete. There are also fine, rather weak growth-striæ, and under a strong lens in favorable light, a very minute and extremely weak spiral striation is visible in places. The last whorl is nearly smooth. Aperture semioval; outer lip slightly obtuse, smooth-edged, a trifle sinuous.

Columella very short, bearing a median, very strong, spirally entering lamella. Length 9, diam. 4.8 mm.; length of the aperture 4 mm.

Juan Fernandez (A. N. S. P. no. 10165).

The shell is narrower and paler-colored than *F. wilsoni*, and plicate below the suture.

5. F. WILSONI n. sp. Pl. 14, figs. 7, 8.

The shell is imperforate, ovate-pyramidal, rather solid, opaque, covered with a glossy yellowish cuticle, distinctly though finely striate, the striæ strongest just below the suture, the base smoother. Outlines of the spire straight. Apex obtuse, rounded, the first 1½ whorls white, smooth. Whorls 7½, almost flat, the last very ventricose, rounded at periphery and base. Suture linear, narrowly impressed. Aperture slightly oblique, light brown within, with a white border near the lip. Outer lip blunt, being slightly thickened. Columella very short, with a very strong, obliquely or spirally-entering median lamella. Parietal callus rather thick, whitish but transparent, not spreading forward. Length 10.5, diam. 5.8 mm.; length of aperture 4.9 mm.

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Juan Fernandez. Type no. 10166 A. N. S. P.

This species has more whorls than *bulimoides* or *consimilis*, and a smaller aperture. The lateral outlines of the spire are almost straight.

Named for Dr. T. B. Wilson, who gave the specimens to the Academy.

6. F. TRYONI n. sp. Pl. 14, figs. 12, 13.

The shell is subimperforate, oblong-conic, thin, translucent, pale yellow, glossy. Spire conic, the apex obtuse and rounded. Whorls 6, but slightly convex. First 1½ whorls smooth, following whorls of the spire very finely and weakly though quite distinctly striate, the striæ curved. Suture bordered by transparence. Aperture irregularly ovate, the outer lip obtuse, whitish. Columella rather wide, concave above and excavated below a very oblique fold. Parietal callus thin and straight. Length 6.6, diam. 3 mm.; length of aperture 3 mm.

Juan Fernandez (no. 10167 A. N. S. P.).

The smallest species of the group as now known. It is much smaller than *F. conifera*, with fewer whorls.

7. F. INORNATA n. sp. Pl. 14, figs. 14, 15.

Shell oblong-conic, imperforate, thin, pale brownish yellow, glossy, somewhat translucent. Spire with very slightly convex outlines and obtuse, rounded apex. Whorls 6¾, but slightly convex, the first 1¾ smooth, the rest sculptured with short, low folds below the suture, and very weak, irregular growth-lines. Aperture semioval, the outer lip white, blunt, with a smooth finish. Columella short, concave above, excavated below the oblique, somewhat lamellar fold. Length 9, diam. 4.25 mm.; length of aperture 4 mm.

Juan Fernandez (no. 10168 A. N. S. P.)

Closely related to *F. philippiana*, but of narrower shape, with a more obliquely entering columellar fold. In the type specimen (pl. 14, figs. 14, 15) this fold is rather weak, but in another shell, which I refer for the present to the same species, it is strong and lamellar.

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8. F. CONIFERA (Reeve). Pl. 14, fig. 5.

"Shell pyramidally conical, whorls 8, rather narrow, rounded, longitudinally obscurely striated, shining, columella short, arched, twisted, attenuately truncated, aperture small, brown-horny" (*Reeve*).

Shell ovate-pyramidal, thin, very finely striatulate, glossy, pellucid, brownish-corneous. Spire long-conic, the apex obtuse. Whorls 8, a little convex, slowly increasing, the last subrotund, about two-fifths of the total length. Columella short, arcuate, twisted, obliquely truncated above the base of the vertical, subrhombic-oval aperture. Peristome acute, unexpanded. Length 12, diam. 5.5 mm.; oblique alt. of aperture 5, width in the middle 3 mm. (*Pfr.*).

Juan Fernandez (Cuming).

Achatina conifera REEVE, Conch. Icon. v, pl. 18, f. 98 (June, 1849).—PFR. Monogr. iii, 495, vi, 255.

Distinct by its long spire and deeply twisted columella. Reeve's figure is copied, and the descriptions of Reeve and Pfeiffer are given.

9. F. SPLENDIDA (Anton). *Cf.* Pl. 14, figs. 9, 10.

"Oval-conic, spire lengthened, 5 whorls, the last ventricose, almost half as long as the whole shell. Transparent, shining, very finely striate, olive-green. Aperture long-oval. Columella strongly twisted, inconspicuously truncate. Length 3½, diam. 1½ lines" (*Anton*).

Opana (Anton).

Bulimus (*Achatina*) *splendida* ANTON, Verzeichniss der Conchylien welche sich in der Sammlung von Hermann Eduard Anton befinden, p. 44, no. 1590 (1839).

? *Achatina splendida* Anton, PFEIFFER in Philippi, Abbild. u. Beschreib. neuer Conch. ii, p. 214, *Achatina*, pl. 1, f. 11 (1847); Conchylien Cabinet, *Bulimus*, p. 339, pl. 37, f. 10-12; Monographia Hel. Viv. ii, 271.—REEVE, Conch Icon. v, pl. 19, f. 100 (1849).—*Spiraxis splendida* Ant., PFR., Monogr. iii, 472; iv, 575; vi, 193.—*Oleacina splendida* ADS., Gen. Rec. Moll. p. 105.—*Stenogyra* (*Nothus*) *splendidula* Anton, E. A. SMITH, P. Z. S. 1884, p. 280.

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There is some doubt whether the species described and figured by Pfeiffer is identical with that of Anton. Anton gives the locality "Opana," meaning the island Opara or Rapa, one of the Austral Group. He gives the shell 5 whorls. Pfeiffer's description follows:

"Shell ovate-conic, thin, striatulate, glossy, olivaceous-corneous; spire conic, apex rather acute. Whorls 6 to 7, a trifle convex, the last about as long as the spire. Columella twisted, very obsoletely truncate. Aperture oblong-oval; peristome simple, acute, columellar margin reflexed in a callus which often spreads outwardly. Length 7.5, diam. 3.5, aperture 3.5 mm. long, 1.66 wide."

"Island of Juan Fernandez (Cuming)."

This form was also recorded by Mr. Smith as collected on Juan Fernandez by the Challenger expedition.

Pfeiffer's figure in the *Abbildungen* of Philippi is copied, pl. 14, fig. 9. Reeve's figure agrees with this except that the columella is more curved and prominent at the base. In the *Conchylien Cabinet* Pfeiffer figures a more ventricose and Bulimoid shell, which certainly looks like a different species, but gives the same description. I have copied this figure also, pl. 14, fig. 10.

10. F. LONGA n. sp. Pl. 14, fig. 6.

The shell is imperforate, oblong-turrite, thin, pale brownish-yellow, somewhat transparent, glossy. Spire long, with nearly straight sides, the apex obtuse and rounded. Whorls 7½, but slightly convex, the first 1¾ smooth, the rest regularly sculptured with straight vertical, fold-like striæ, which weakly crenulate the very narrow prominent border below the suture. The striæ became less regular on the last whorl or two, and the sutural border loses its prominence. In some places a very minute spiral striation may be made out in favorable light. The aperture is irregularly ovate; outer lip simple; columella subvertical above and somewhat excavated below the low, oblique, sublamellar fold. Length 9.9, diam. 4 mm.; length of aperture 4 mm.

Juan Fernandez (no. 10168 A. N. S. P.).

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This species seems to resemble *F. splendida* (Anton) in contour, but according to Anton that has but 5 whorls. Pfeiffer's *splendida* is, according to the figure, a more conic shell. Under the circumstances it is probably best to give a recognizable account of the form before me, leaving the question of its possible identity with one or other of the forms described as *splendida* for future decision.

Genus CARELIA H. and A. Adams.

Carelia H. & A. Ad., Genera of Recent Mollusca ii, p. 132 (February, 1855).—Pfr., Monographia Heliceorum iv, 571; vi, 188; viii, 250.—Albers-Martens, Die Heliceen 1860, p. 208 (type *Achatina bicolor* Jay).—Gulick, Proc. Zool. Soc. Lond. 1873, p. 91 (type *C. adusta* Gld.).—W. G. Binney, Ann. N. Y., Acad. Sci. iii, p. 103 (jaw and teeth).—Ancey, Mémoires de la Société Zoologique de France vi, 1893, p. 321 (monograph).—Borcherding, Monographie der auf der Sandwichinsel Kauai lebenden Molluskengattung Carelia, in Abhandlungen Senckenbergischen Naturforschenden Gesellschaft xxxii (Feb., 1910), p. 225.

The shell is imperforate, oblong-turrite, solid; embryonic shell conic, with slightly obtuse apex and flat whorls; first half whorl smooth, the next whorl or two with sculpture of arcuate axial striæ or riblets, which are often split; neanic and adult stages irregularly striate or nearly smooth, sometimes with spiral lines or ribs, the whorls slightly convex, or with one or two spiral carinæ. Aperture ovate; outer lip simple and acute; columella concave, obliquely or vertically truncate below, and bearing a small callous lamella. Axis slender and nearly straight in the inner whorls, becoming sinuous in the last.

Soft anatomy unknown, except the jaw and teeth, which have been described and figured by Binney. The jaw of *C. bicolor* (pl. 21, fig. 12) "is low, slightly arcuate, with but little attenuated, blunt ends; anterior surface with ten stout ribs, denticulating either margin.

"Lingual membrane of *C. bicolor* (pl. 21, fig. 11) long and narrow; teeth 37,1,37, of same type as in the species of

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Laminella, Newcombia and *Leptachatina*" (*W. G. Binney*). Centrals much narrower than the laterals with a relatively very small tricuspid reflection. Lateral teeth with the inner cusp as long as the basal-plate, ectocone small as usual. Marginal teeth with the ectocone bifid.

Type *C. bicolor* (Jay). Distribution, Islands of Kauai and Niihau.

Carelia was proposed by Henry and Arthur Adams for the species *bicolor, cochlea, fuliginea, newcombi* and *paradoxa*, and placed in the genus *Achatina* next to *Homorus*. The first of these species was selected as type by von Martens, who retains the genus in practically the same position. Gulick in 1873 removed it to the *Achatinellinæ*, a position confirmed by Binney's examination of the teeth, and approved by all subsequent students. A full account of the soft anatomy is still wanting.

The genus contains the largest land snails of the Hawaiian group. We have but little information upon their distribution in Kauai, and no real advance in knowledge of the races can be made until the results of field work in that island are accessible.

According to Pease, "The species of *Carelia* are commonly found on the sides of precipitous rocks of the mountains, under stones and trunks of dead trees. They do not live in large numbers; one finds solitary individuals, or pairs. All of them are rare, even in the places where they are most often found. *C. adusta* Gld. is the only exception in this respect." (*Pease*, J. de C. 1870, 402.)

"The young are similar to the young of *Kauaia* and of most of the true *Achatinellidæ* in general aspect, but they retain an angulated base and primitive aspect until a late substage of the neanic in some primitive species like *C. bicolor, adusta* and *sinclairi*. These resemble the adult whorls of *Kauaia kauaiensis* except in having angulated instead of carinated basal volutions and the small but still open umbilicus. The derivation appears therefore to have been from some form having angulated base, convex dorsal sides and general form of the full grown shells of *Kauaia*, but this was

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not a carinated shell, and the surface was perhaps smoother than in *K. kauaiensis*. The immediate ancestor of *Carelia*, in other words, was probably a Kauaia-like shell with angulated base, smooth whorls and had a twisted columella with a small perforation. This form, if in existence now, would probably be placed between *Cyclamastra* and *Kauaia* on account of its columella and aperture, or be classified as a primitive form of *Kauaia* itself'' (*Hyatt*).

The amastroid stage of *Carelia* is shown in pl. 16, fig. 7, representing the neanic stage of *C. bicolor*.

Key to Species of Carelia.

a. Later whorls angular or subangular at the shoulder; periphery flattened, base obtusely angular.

b. Diameter nearly half the length; no spiral striation; 25x12 mm. with 6⅓ whorls. *C. b. angulata*, no. 10 *f*.

*b*¹. Longer, more slender, whorls 7 to 9.

c. Last whorl very dark and *smooth*, strongly biangular, with a creamy zone above the angle; diam. one-third the length, or more. *C. cumingiana*, no. 9.

*c*¹. Last whorls biangular, the upper angle rounded, striate, lower angle strong; red-brown with a sutural light line; diam. less than one-third the length, 47x14 mm. *C. rigida*, no. 8.

*c*². Lower angle rounded, upper acute or weak; usually a broad white zone below suture; shell long, slender. *C. dolei*, no. 7.

*a*¹. Whorls not angular at the shoulder.

b. Later whorls having more or less coarse spiral striation.

c. Length usually less than 40 mm.; red-brown with a white band below suture; strong, unequal spiral cords. *C. cochlea*, no. 6.

*c*¹. Similar but with well-rounded last whorl and few, very weak spirals. *C. bicolor*, no. 10.

*c*². Larger shells, length 45 to 80 mm., with dark base and lighter color above. *C. turricula*, no. 1; *C. paradoxa*, no. 2.

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b^1. Not spirally striate.

c. Large, length 50 mm. or more.

d. Last whorl rounded; red-brown, fading toward the apex; rather coarse striæ; 65x 23 mm. *C. pilsbryi*, no. 3.

d^1. Last whorl more or less flattened, subangular below.

e. Olive-green, 69x19 mm., 8-9 whorls. *C. olivacea*, no. 4.

e^1. Blackish, suture yellowish, 55 x 20 mm., 7 whorls. *C. o. variabilis*, no. 4*a*.

e^2. Reddish-chestnut, fading upwards, suture white margined; 54x17 mm., whorls 9. *C. hyattiana*, no. 5.

c^1. Length not over 40 mm.

d. Last whorl rounded, rarely with a weak basal angle; shell dark brown or black, often light above or with a light sutural band. Kauai. *C. bicolor*, no. 10.

d^1. Whorls less convex, coarsely plicate-striate. Niihau. *C. sinclairi*, no. 11.

1. C. TURRICULA (Mighels). Pl. 19, fig. 1.

"Shell cylindrical, turrited, sometimes dark, sometimes light brown, imperforate; whorls 10, convex, more or less distinctly striate transversely; incremental striæ coarse; aperture oblong; lip simple, acute. Length 2.75 inches, diam. .8 inch." (*Mighels*).

Kauai: Hanalei (Baldwin, Perkins).

Achatina turricula MIGH., Proc. Boston Soc. Nat. Hist. ii, 1845, p. 20.—PFR., Monogr. ii, 261.—*Carelia turricula* Migh., KOBELT, Jahrb. D. Malak. Ges. ii, 1875, p. 225, pl. 7, f. 1.—BORCHERDING, Abh. Senck. Nat. Ges. vol. 32, 1910, p. 229, pl. 19, f. 2, 3 (form *newcombi*).—*Achatina newcombi* PFR., P. Z. S. 1851, p. 262 (1853).—*Spiraxis n.*, PFR., Monogr. iii, p. 470.—*Achatina obeliscus* REEVE, Conch. Icon. v, pl.

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23, f. 129 (March, 1850).—*Carelia turricula* Migh., var. *azona* ANCEY, Proc. Malac. Soc. vi, p. 121 (1904).—*Carelia cocklea* GULICK, Evolution, Racial and Habitudinal, 1905, p. 38, pl. 1, fig. 1.

The summit is rather pointed, the first 3 whorls being straight-sided, subsequent whorls are slightly convex, and last whorl is somewhat cylindric, being flattened in the middle, convex or subangular above, and angular at the periphery, below which it tapers straightly to the base. Apical sculpture as in the other species; the spiral sculpture begins on the fourth whorl as spiral series of long granules. On the last 3 or 4 whorls there are several low, cord-like spirals, more or less knotted by coarse, irregular, longitudinal growth-folds. This sculpture varies from strong to subobsolete in different specimens, and is wanting on the base. There is also a very dense, fine, wavy microscopic spiral striation, visible in the most perfect shells, but readily worn off.

The color varies from rather bright yellow to dark chestnut, the base being darker, of a chocolate shade. In the color-form *newcombi* there is a pale belt below the periphery.

Mr. Ancey's var. *azona* is identical with the typical *C. turricula*.

1*a*. Var. NEWCOMBI Pfeiffer. Pl. 19, figs. 4, 5, 6.

Chestnut-colored with *a pale yellow belt below the peripheral angle*, the base black. Length 71, diam. 19, aperture 21 mm. (*Pfr.*). This color form differs from the type only in the conspicuous yellow belt bounding the chocolate basal area. Sometimes the upper surface is yellow with an orange-brown tint, darker than the belt (fig. 4). The spiral sculpture varies in prominence among individuals of the same lot. In some shells the spirals are very conspicuous (figs. 4, 5), in others almost obsolete.

✓ 1*b*. Var. OBELISCUS Reeve. Pl. 19, figs. 7, 8.

The last 3 or 4 whorls have *coarse, irregular wrinkles of growth* and several *coarse, low spiral cords*, often more conspicuous than in the typical *turricula*. They are dull brown,

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with pale or whitish streaks and spirals due to wear. "Last whorl banded with chestnut black around the columella" or the whole base may be black, with no light band below the peripheral angle. Aperture blue-white inside, with a wide black border in the outer lip.

Fig. 8 is copied from Reeve. Fig. 7 represents a specimen from Hanalei, no. 2351 Cooke coll. It measures, length 68.5, diam. 21.5 mm., with 9½ whorls.

I cannot agee with Borcherding that *obeliscus* is specifically distinct from *turricula*. The difference in sculpture which he relies upon is very inconstant.

2. C. PARADOXA (Pfeiffer). Pl. 19, fig. 3.

Shell turrite, solid, distinctly and closely granulate, black-brown; spire long, forming an acute cone above. Whorls 8, convex, the upper ones remotely costate, the last whorl two-sevenths the total length, angular below the middle, smooth; aperture a little oblique, subrhombic, bluish within, columella calloused, white, twisted, subtruncate at the base; peristome unexpanded, acute. Length 46, diam. 16 mm., aperture 15 mm. long, 8 wide. (*Pfr.*).

Kauai (Dr. Newcomb, in Cuming coll.)

Spiraxis paradoxa PFR., P. Z. S. 1853, p. 128; Monographia iv, 572.—*Carelia p.*, PFR., Monographia viii, 251.—PEASE, P. Z. S. 1871, p. 473.—BORCHERDING, Monogr. Carelia p. 231, pl. 19, fig. 5.

Pfeiffer also described a var. *b*; larger, white becoming orange-red towards the apex, the last whorl deep purple-chestnut around the columella; length 60, diam. 18 mm. Borcherding's figure is copied; but it seems to represent only an exceptionally granose specimen of *newcombi*.

3. C. PILSBRYI Sykes. Pl. 18, fig. 10.

"Shell elongate, spire much produced, imperforate; sculpture consisting of well-marked, irregular, longitudinal lines, these gradually becoming weaker towards the protoconch, which is smooth; color of the last whorl red-brown, gradually fading on the upper whorls till the protoconch is only faintly

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tinged. Whorls 8, the last measuring more than half the entire length, moderately inflated, with a well-marked suture; mouth lunate, outer lip (broken) hardly thickened at all, the white columellar margin reflexed and slightly expanded." Length 65, diam. 23 mm. (*Sykes*).

Kauai.

Carelia pilsbryi SYKES, Proc. Malac. Soc. London viii, April, 1909, p. 204, with fig.—BORCHERDING, Monogr. Carelia, p. 232, pl. 19, f. 6, 7.

"A single specimen, purchased from the collection of the late Mr. Rogers, has remained some years unnamed in my collection. As other workers have also been unable to identify it, I now give a description and figure.

"From *C. bicolor* Jay, it differs in its larger size and also its color; from *C. cochlea*, Rve., and *cumingiana*, Pfr., in the absence of keeling and the more inflated whorls; from *C. dolei* Ancey, its size will readily distinguish it; from *C. olivacea* Pease, it differs in color and shape; from *C. paradoxa* Pfr., it may be known by the absence of granular sculpture; from *C. turricula* Mighels, it may be separated by the coloring, length of the last whorl, and lack of keel at the base. *C. sinclairi* Ancey, is unknown to me, and *C. glutinosa* Ancey, is not, I believe, really a Hawaiian shell. I have only seen a single specimen of *C. pilsbryi*, and the species is, I should think an extinct one, like some others of the group." (*Sykes.*)

4. C. OLIVACEA Pease.

"Shell elongately turrited; whorls 8-9, flatly convex, smooth or obscurely ribbed transversely, the last roundly angulate at its base; aperture small, ovate, about one-fifth the length of the shell; columella strongly arched and obliquely truncate at base; covered with a greenish-olive epidermis, which often, after the death of the animal, darkens; the suture is sometimes margined with a white or light colored band, which is free of epidermis; aperture bluish, edge black, base of columella dark-chestnut." (*Pease*).

Length 69, diam. 19 mm.

Sandwich Islands, Kauai (Pease).

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Carelia olivacea PSE., American Journ. of Conch. ii, p. 293 (Oct. 1, 1866).—*C. variabilis* PSE., Journ. de Conchyl. 1870, p. 402, with var. *viridis;* P. Z. S. 1871, p. 473, with var. *olivacea* and *viridans.*—BORCHERDING, Monogr. *Carelia,* 1910, pp. 233-235, pl. 19, f. 8, 9.

This was described from a single example, which Pease afterward considered to be "a mere variety of *C. variabilis.*" Pease's account is given in full. No other definite information bearing upon the forms has been published, but Borcherding has figured a shell which he takes to be *variabilis.* One of his figures is copied, pl. 19, fig. 2.

4*a*. Var. VARIABILIS Pease.

Shell elongate-turrite, solid, transversely irregularly roughly raised-striate; blackish, the suture bordered with yellowish, spire reddish-brown. Whorls 7, flattened; the last two-fifths the length of the shell, sometimes angular below the middle. Aperture vertical, ellipsoidal, blue within; columella arcuate, somewhat calloused, plicate at the base, white, truncated basally; peristome unexpanded, acute. Length 55, diam. 20 mm. (*Pse.*)

Var. *viridis.* Shell wholly green, with no band. (*Pse.*)

Kauai: this species is found in a space of over 15 miles on the eastern part of Kauai, therefore occupying a larger area than any other of the genus (*Pse.*).

"The form most nearly related is *C. fuliginea* Pfr. *C. olivacea* Pease, which I described from a single individual, is probably only a mere variety of *C. variabilis.*

"When the animal becomes adult it vacates the upper whorls; hence the spire in all the living individuals I collected is as though dead, decolored and turning light brown. It is probably the largest species of Carelia. I found the last three whorls of a shell which must have had a length of 3 inches when living." (*Pse.*)

Pease subsequently (1871) mentions, but does not define, a "var. *viridans*", doubtless an error for *viridis.*

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5. C. HYATTIANA Pilsbry, n. sp. Pl. 21, figs. 1, 2.

The shell resembles *C. turricula* in shape. The embryonic whorls and up to the end of the 4th taper more rapidly than those following. The first 3½ are bicolored and nearly flat, with a sculpture of narrow, curved, axial grooves, separated by much wider intervals. They are somewhat worn in the type. The rest of the whorls are rather weakly and about equally convex, with sculpture of faint growth-wrinkles and indistinct traces of fine, dense, wavy spiral striolation. The color of the post-embryonic whorls is fallow or tawny yellow; this deepens to a rich chestnut and then dark reddish chestnut on the last whorl, which is darkest basally. A rather narrow (about 1.5 mm.) snow white zone borders the suture below, on the last five whorls. The aperture is ovate. Columella vertical, brown, with a very weak basal truncation and no noticeable spiral lamella.

Length 54, diam. 17.2, length of aperture 17 mm.; whorls 9.

Hawaiian Is. Type no. 10132 A. N. S. P., presented by Dr. T. B. Wilson.

This species is based upon a fossil shell which was associated with *C. dolei* in the collection, and which evidently came from the same formation. It differs from *C. dolei* in wanting an angle or carina at the shoulder at all stages of growth. On the last whorl there is an obtuse but quite appreciable basal angle, which, with its shorter aperture, serves to differentiate this species from *C. pilsbryi* Sykes.

Compared with *C. turricula*, this species is less robust at all stages of growth; the columellar twist is weaker, and the coloration different.

C. olivacea Pease may be identical with this shell, but the proportions, from Pease's measurements, must be much more slender. The var. *variabilis* of Pease, of the same length as *hyattiana*, is wider and has two whorls less.

✓ 6. C. COCHLEA (Reeve). Pl. 18, figs. 5, 6, 8.

Shell turrited, slowly tapering, more rapidly so near the summit; reddish brown, darker towards the apex, with a

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white band revolving below the suture throughout. The first three whorls are nearly flat, the rest moderately convex, the last whorl obtusely angular peripherally. The early whorls have curved riblets, as usual in the genus; on the fourth whorl spiral sculpture begins, often abruptly becoming stronger at or near the end of the fourth whorl. Subsequent whorls have 5 or 6 strong unequal spiral cords and light growth-lines; base smooth. The aperture is rhombic; columella descends in a long spiral curve, the basal truncation being very weak.

Length 38, diam. 13.7 mm.; whorls fully 8. (fig. 6).

Length 39, diam. 14.5 mm.; whorls 7½ (Reeve's type, according to Pfr.; fig. 5).

Kauai.

Achatina cochlea REEVE, Conch. Icon. v, pl. 1, f. 5 (Feb., 1849).—PFR., Monogr. iii, p. 498; Conchyl. Cab. p. 347, pl. 38, f. 7.—*Carelia cochlea* PFR., Monogr. viii, 251.—SYKES, Proc. Mal. Soc. Lond. viii, 1909, p. 204.—BORCHERDING, Monogr. Carelia, p. 236, pl. 20, figs. 3, 4.

The numerous strong spiral cords of this species differentiate it from other forms having a white sutural band. It is a rare snail, the exact locality is still unknown. All the specimens we have seen are "dead" shells, and we presume that Reeve's type was equally so.

7. C. DOLEI Ancey. Pl. 18, figs. 1 to 4; pl. 16, fig. 10.

Shell elongate-turrited, solid, (dead), without gloss; intense wine-brown colored, darker at the acute apex and the aperture. Striate, the striæ less distinct at the aperture. Spire very much lengthened, slowly tapering, a little more rapidly so above. Whorls 9 to 9½, slowly increasing, the first scarcely convex, suture linear, following 5 whorls at first sloping, then angular above the middle, flattened below the angle; suture impressed; the last whorl has an upper angle, with another obtuse one below the middle, sides flat, tapering downward. Aperture oblong, acute above, tapering, brown inside. Columella thick, strongly and obliquely truncate, white, arcuate above; parietal callus strong. Length

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45 to 51, diam. 14 to 16, alt. of aperture 12 to 13 mm. (*Ancey*).

Kauai: Hanalei (Baldwin).

Carelia dolei ANCEY, Mém. Soc. Zool. France 1893, vi, p. 328 (1894).—BORCHERDING, Monogr. Carelia, p. 237, but probably not pl. 20, f. 5, 6.—*Carelia cumingiana* var. *kobelti* BORCHERDING, Monogr. Carelia p. 239, pl. 20, f. 1, 2.

This species was based on dead examples, presumably fossil. There is a superb set of 91 shells from sand dunes along the shore, Haena, northern Kauai, in the collection of Mr. C. M. Cooke. It is a highly variable form, closely related to *C. cumingiana*, from which it differs by the more slender spire, the generally weaker basal angle, and the weaker development of minor spirals on the neanic whorls.

The upper angle or keel begins on the fourth whorl (pl. 16, fig. 10); it varies widely in degree of prominence, and sometimes becomes subobsolete on the last two or three whorls. In a few cases it is doubled (pl. 18, fig. 3). The basal angle is usually rounded off, and seems never to be so strong as in *C. cumingiana*. The more minute surface-sculpture is like that of *cumingiana*, except in the weaker spirals. As in *cumingiana* the flat, sloping shoulder is often weakly plicate; otherwise the later whorls appear smooth under the lens.

The specimens are in large part bleached, but many show color. The first four whorls are usually purplish with a narrow subsutural white border. This color fades to white on the following whorls. The last two or three whorls are chestnut, the base darker, with a wide white zone below the suture. This zone includes the shoulder-keel, thus differing from *C. cumingiana* in which the white zone lies above the keel. In a few examples the early whorls are white. Several shells in which the upper carina is weak on the later whorls, want the subsutural white zone. They are chestnut-colored, paler just below the suture and in the upper part of the spire; apical whorls either pale or dark, (fig. 4). This seems to be the typical color form, described by Ancey.

The specimens figured measure as follows:

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Length 44.5, diam. 15 mm.; whorls 8½.
Length 46.5, diam. 13.5 mm.; whorls 9.
Length 43, diam. 14 mm.; whorls 8½.
Length 36, diam. 13.5 mm.; whorls 7¾.

This species is slightly more advanced in evolution than *C. cumingiana*, shown by the frequent loss or weakness of the keel on the last whorl, a feature of senility.

Borcherding's *C. cumingiana* var. *kobelti* was based upon specimens resembling my figs. 1 and 2, and probably from the same locality. The form he figures as typical *dolei* wants the spiral angles described by Ancey. If the specimen is *dolei*, it is very far from typical.

8. C. RIGIDA Hyatt, n. sp. Pl. 21, figs. 8, 13.

The shell is slender, turrited, the last 5 whorls increasing slowly, those earlier much more rapidly; red-brown, with a narrow whitish band below the suture on the last 5 whorls, its lower edge not sharply defined; the upper whorls and the base somewhat darker than the intermediate whorls. Whorls 8¾, the upper ones but slightly convex, the last five moderately convex, chiefly just above the middle of each, where there is a group of about 3 weak spiral striæ on the last 3½ whorls. The last whorl is convex close below the suture, distinctly flattened peripherally, angular at the base, slightly concave below the angle. Aperture small. Columella with the twist not very prominent. Length 46.8, diam. 14 mm., length of aperture 13 mm.

Kauai.

This species is related to *C. cochlea* and *C. dolei*, and may turn out to be a form of the latter. The strong basal angle, the spiral striæ of the upper surface, and the much lengthened spire of many whorls are its chief characters. Description and figures from specimen in coll. Dr. C. Montague Cooke, labeled by Hyatt, whose account follows.

This species is similar to *Carelia cumingiana*, but the white band is much narrower, being often a mere trace, and the shoulder less prominent. The apertures are however very much alike, owing to the rate of growth, the flatness of the

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outer part of the dorsum or sides, and the flattening of the base. The dorsum may be covered with longitudinal [spiral] ridges until near the basal angle. There are five shells from Kauai in the Boston Society collection, and one shell in Cooke's collection, from Kauai (*Hyatt*).

9. C. CUMINGIANA (Pfeiffer). Pl. 21, figs. 3, 4, 5; pl. 18, figs. 7, 9.

The shell is turrited, rather solid, smoothish. The spire tapers slowly, but terminates above in a more rapidly tapering cone. The first half or three-fourths whorl is smooth; then rather coarse, curved, vertical ribs set in. On the third whorl these become finer and more or less split into sharp striæ. About the middle of the third whorl some shallow spiral sulci appear and part of the striæ are cut into oblong granules; at the end of 3½ whorls, weak cords appear at the shoulder and close above the suture below; these gradually enlarge into conspicuous angles or keels, the lower one usually covered at the suture except on the last whorl. The vertical sculpture gradually diminishes, leaving the last two whorls smooth. The embryonic whorls are bicolored, purple-black and tawny, but the dark lower zone gradually fades as growth proceeds, and is usually narrow or inconspicuous after the 4th whorl. The intermediate whorls of the spire are some shade of tawny brown. A pale zone below the suture begins on the fifth whorl, becoming opaque white on the last two or three whorls. The last whorl is biangular, smooth, and very dark brown or black below the white zone.

Aperture trapezoidal, bluish white within, with a broad black margin within the thin, acute lip. Columella concave, bluish white with a brown edge, narrowly truncate at base; spiral lamella above the truncation moderate or inconspicuous.

Length 43.5, diam. 16 mm.; whorls 8.

Length 46, diam. 14.5 mm.; whorls 8.

Length 37, diam. 15.5 mm.; whorls 7.

"Length 48, diam. 16 mm.; whorls 8" (Pfr., type).

Kauai.

Spiraxis cumingiana PFR., P. Z. S. 1855, p. 106, pl. 32, f. 1;

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Monogr. iv, 572.—*Carelia c.*, PFR., Monogr. viii, 251.—BORCHERDING, Monogr. Carelia p. 238, pl. 19, f. 10, 11; pl. 20, f. 5, 6.

This species differs from *C. bicolor* by the strong development of spiral sculpture. At least the fourth whorl has numerous low spiral cords; the shoulder keel is conspicuous on the last three whorls, and the strong baso-peripheral angle limits a flat peripheral area on the last whorl. The white band below the suture varies but little in width, in the series of 14 specimens examined. In *C. dolei* the spire is decidedly more slender above, and the sculpture of the early neanic whorls differs.

10. C. BICOLOR (Jay). Pl. 20, figs. 1, 2, 3, 4, 7.

Shell oblong-ovate, solid though not thick, spire red-brown, darkening on the apical and penult. whorls, the last whorl or two black or black-brown, with a cream-white zone below the suture; this zone ascends the spire 2½ or 3 whorls, and reappears on the earliest whorls. The first 3½ whorls are but slightly convex and form a conic terminal cone; following whorls become decidedly convex, and taper more slowly. The indistinct spirals of the early neanic whorls often became low subobsolete cords or angles on the last whorl. The angle bounding the base, distinct in the neanic stage, is sometimes traceable in adult shells. Aperture very dark with a bluish iridescence inside. The columella is moderately concave, narrowly truncate at the base, and bears a very obliquely descending white lamella.

Length 36.5, diam. 15, length aperture 13 mm. Whorls 7½.

Length 34, diam. 13.5, length aperture 13 mm. Whorls 7½.

Kauai: Hanekapiai; on the ground, under Dracæna leaves, on terraces of the slope at about 800 ft. (C. M. Cooke).

Achatina bicolor JAY, Catalogue of Shells, 3d edit., 1839, p. 119, pl. 6, fig. 3.

The typical form of *C. bicolor* is a rare shell in collections. The specimens described and figured are from the collection of Mr. C. M. Cooke.

The width of the subsutural white band varies a good deal

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—from 1½ to 5 mm. wide in shells about 35 mm. long. In some shells the junction of the white band with the dark color is a sharp line; in others the dark color fades gradually through red-brown; again, bright blue appears at the upper edge of the darker color. The embryonic whorls and a young shell in the Amastroid stage are shown in pl. 16, figs. 7 and 9.

The following form seems to be a synonym.

Var. *suturalis* Ancey. "The shell is like typical *C. fuliginea* except that it is marked with more conspicuous superficial spiral lines on the last whorl; upper part of the last whorl margined broadly and diffusely with buff-white, and sometimes encircled below the sutural zone with a few narrow lines of the same color. Length 38, diam. 16.5, alt. aperture 18.5 mm. Kauai (Baldwin). In this variety the pale band is not well defined as in *C. bicolor* Jay, which is usually considered a form of the same species." (*Carelia fuliginea* Pfr., var. *suturalis* Ancey, Proc. Malac. Soc. London, vi, 122, 1904).

10*a* C. B. HYPERLEUCA n. var. Pl. 20, figs. 5, 6.

Upper (outer) surface of the last two or three whorls white, with a very thin, pale yellowish cuticle; base chocolate or black, early whorls colored like *bicolor*. There are intergrading specimens connecting this with *bicolor*, such as pl. 20, fig. 5, and others connecting with *adusta*, pl. 20, fig. 7, in which the upper surface of the last whorl is red-brown, much lighter than the base. In fact, the color-forms of *C. bicolor* probably have no existence as separate races. Their status must be determined by the naturalist in the field.

10*b*. C. B. ADUSTA Gould. Pl. 20, figs. 8, 9, 10.

"Shell turrite, with pyramidal apex, imperforate, solid, blackish-brown, pale above. Whorls 7, convex, lightly striate, the last subcarinate. Aperture oval, opaline within; lip simple, acute, black; columella ivory-like, produced in a tooth anteriorly. Length 1½, diam. ⅜ inch." (*Gld.*)

Kauai: Haena.

Achatina adusta GLD., Proc. Boston Soc. Nat. Hist. ii, 1845, p. 26.—*Achatina fuliginea* PFR., P. Z. S. 1852, p. 66

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(1854); Monogr. iii, 490; Conchyl. Cab. p. 367, pl. 43, f. 21, 22.—*Achatina bicolor* Jay, PFR., Conchyl. Cab. p. 335, pl. 39, f. 6, 7.—DESHAYES in Fér., Histoire, p. 188, pl. 122, f. 4, 5. — REEVE, Icon. v, pl. 1, f. 4. — *Carelia bicolor* Jay, BINNEY, Proc. A. N. S. Phila. 1876, p. 185, pl. 6, and Ann. N. Y. Acad. Sci. iii, p. 103, pl. 6, f. I (dentition), pl. 16, fig. D (jaw).

This form differs from *C. bicolor* only in the absence of a white zone below the suture. The last one or two whorls are chocolate or black, the spire red-brown, and the embryonic whorls dark again above the suture. Often the red-brown of the spire extends upon the upper half of the last whorl, the basal half remaining black. Mr. C. M. Cooke found *adusta* living with true *bicolor* at Haena. All the figures published as *bicolor* represent *adusta*, except Jay's original illustration and Borcherding's figures.

10*c*. C. B. FULIGINEA Pfeiffer. Pl. 21, figs. 9, 10.

"Shell ovate-turrite, solid, roughly striate, glossy, sooty-black; spire turrite the apex acute. Whorls 6½, convex, the last about two-fifths the length, very obsoletely angular below the middle columella arcuate, vertically truncate at the base. Aperture slightly oblique, subrhombric-oval; peristome simple, acute. Alt. 36, diam. 16 mm." (*Pfr.*).

Pfeffer's original figures are copied. Borcherding considers this form specifically distinct from *adusta* on account of its color, which is black with no visible indication of brown, and its luster, *fuliginea* being glossy when the cuticle is preserved, while *bicolor* and *adusta* are dull. Pfeiffer's original figures show brown upper whorls. In the series before me I cannot trace such a difference in luster between the forms as Borcherding claims. In fact, I am much disposed to rank *fuliginea* as a synonym of *adusta*. References are given under *adusta*.

Borcherding has described several supposed varieties of *adusta* as follows:

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10*d*. Var. *minor* Borcherding. Pl. 20, figs. 13, 14.

"A quite small dark black-brown form only 24 mm. long" (*C. adusta* Gld. var. *minor* Borcherding, Monogr. Carelia p. 244, pl. 20, f. 17, 18).

10*e*. Var. *zonata* Borcherding. Pl. 20, fig. 15.

"An elegant form of black-brown color and 28 mm. long. Comes near the typical form of *adusta* but has a sharply defined white band below the suture" (*C. adusta* Gld. var. *zonata* Borcherding, Monogr. Carelia p. 244, pl. 20, f. 13, 14).

A "*Carelia adusta* Gould var. *minor* form *zonata*" Borcherding (pl. 20, figs. 11, 12) is defined as "a third pretty form of red-brown color and 25 mm. long stands near var. *minor* but has a sharply defined white band below the suture" (*Borcherding*, t. c. p. 244, pl. 20, f. 15, 16).

The "*zonata*" forms are apparently small forms of *bicolor*.

10*f*. C. B. ANGULATA Pease. Pl. 20, fig. 16.

"Shell generally more slender, whorls above broadly angular. The wide and acute angulation which occupies the greater part of the width of the whorls gives this variety a particular aspect, which I think should be distinguished by a special name" (*Pease*).

Carelia adusta var. *angulata* PEASE, Journ. de Conchyl. 1870, p. 403.

The specimen figured measures, length 25⅓, diam. 12 mm., having 6⅓ whorls. The first whorl is smooth, the next two rather strongly costulate, about as in pl. 16, fig. 9. Then the surface becomes striate. At the first third of the fourth whorl an angle at the shoulder begins, becoming stronger to the last whorl, where it is rather acute, the surface slightly concave above and below it. A less acute angle divides the flat peripheral from the slightly convex basal surface. The embryonic whorls are bicolored, the upper third pale fleshy brown, lower two-thirds dark red-brown; following whorl light fleshy brown, becoming darker on the penult., dark brown on the last whorl, but pale below the suture.

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The spire widens more rapidly than in *C. dolei*, and the lower angle is decidedly stronger. In *C. cumingiana* the surface is smoother, the coloration much more brilliant, and there is more sculpture on the first neanic whorl.

11. C. SINCLAIRI Ancey. Pl. 16, fig. 8; pl. 21, figs. 6, 7.

Shell subfossil, reddish white or fleshy whitish, with the aperture and part of the last whorl before it usually violet-red; scarcely shining, solid, the young very narrowly perforate, generally imperforate; oblong-tapering. Spire conoid with subconvex outlines, a little obtuse. Whorls 8, the first 4 smooth, the rest obliquely and closely, subirregularly plicate, upper whorls flattened, the lower a little convex, last whorl ovate, rounded. Suture more or less distinctly margined below, simple above. Aperture suboblique, tapering-oval, narrow above and below, angular above. Columella arcuate, thickened, somewhat twisted, obliquely and lightly truncate above the base. Basal margin forming an angle with the columella, outer lip regularly elliptical. Peristome simple, acute, unexpanded. Length 32 to 37, diam. 14 to 16, alt. aperture 12 to 14 mm. (*Ancey*).

Island of Niihau.

Carelia sinclairi ANCEY, Mém. de la Soc. Zool. de France v, 1892, p. 720; vi, 1893, p. 322.—BORCHERDING, Monogr. Carelia, p. 246, pl. 20, f. 19, 20.

"It is distinguished easily by the oval shape, oblong last whorl without angularity, the striation and the general appearance resembling *Amastra violacea* Newc."

From the freshness of some of the specimens Mr. Borcherding concludes that the species is perhaps still living in some secluded valley in the somewhat wooded interior of Niihau.

Specimens were distributed many years ago by Dr. Wesley Newcomb under the (unpublished) name *Carelia extincta* Nc. One of these is figured on pl. 16, fig. 8. The first whorl is smooth, the next very finely striate. While about equal to *C. b. adusta* in size, this species differs by its less convex, coarsely striate whorls and margined suture.

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This species and *C. bicolor* resemble *Amastra* much more closely than the species having the basal volution angulated.

Species incorrectly described as Carelia.

C. glutinosa Ancey.

Shell long-conoid, imperforate, solid; white under a varnish-like glossy buff cuticle, which is darker on the last whorl, yellowish-green at the summit. Spire long-conic, subacute, regularly tapering to the summit. Whorls 7, flattened, the lower ones a little convex, grooved with very close, slightly oblique growth-striæ, which are somewhat obsolete in the last two or three whorls, very distinct in the upper whorls, and are especially impressed at the linear suture; last whorl smooth, oblong, obtusely angular at the periphery (perhaps by accident). Aperture oblique, rather wide, scarcely angular outwardly, tapering above and below, the throat white. Peristome simple, acute, unexpanded, the margins remote. Length 24, diam. 10, alt. of aperture 8.5 mm. (*Anc.*)

Habitat unknown.

Carelia glutinosa Anc., Mémoires de la Société Zoologique de France vi, p. 324, 1893.

"This very characteristic species has been in my collection several years. It was formerly in the Boivin collection. It is the smallest of the genus, and easy to recognize by the long cone of the spire, the brilliant yellow cuticle, and the shape of the aperture, wide in the middle, etc." (*Anc.*)

This species is not Hawaiian but belongs to the African group *Homorus* or *Bocageia* in *Achatinidæ* (Vol. XVII).

Genus PTERODISCUS Pilsbry.

Pterodiscus Pils., Manual of Conchology (Series 2), IX, p. 36, November 16, 1893, type "*H. alata* Pfr." Pils., = *P. wesleyi* Sykes. — Sykes, Fauna Hawaiiensis, Mollusca, 1900, p. 292.—Pilsbry and Vanatta, Proc. A. N. S. Phila. 1905, p. 572. — *Helicamastra* Pilsbry and Vanatta, Proc. A. N. S. Phila. 1905, p. 570, type *Amastra discus.—Tropidoptera* Ancey, Bull. Soc. Malac. France vi, 1889, p. 191,

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for *Helix alata* Pfr. Not *Tropidopterus* Blanchard 1845 (Coleoptera).

Amastrinæ with the shell *lens-shaped or planorboid, much wider than high*, umbilicate, *thin, fragile*, dull brown, composed of few (3½ to 5) whorls, which are carinate or angular peripherally at all stages of growth; *peristome thin, or fragile*, the columellar margin dilated, elsewhere simple. *A columellar lamella is present at all stages of growth.* The embryonic shell, of about 1¾ whorls, is *flat above*, conically tapering below, with microscopically crinkled cuticle and sculpture of weak, irregular radial wrinkles chiefly on the last half whorl. The adult shell is often loaded with foreign material adhering chiefly in the form of an irregular extension of the periphery. Viviparous.

Type: *P. wesleyi* Sykes. Distribution: Lanai and Oahu, living on the ground.

Pterodiscus was clearly derived from *Amastra*, agreeing with that group in the dentition, the color and texture of the shell and in habits.

Pterodiscus differs from *Planamastra* and *Armsia* by the *presence of a columellar lamella at all stages of growth*, from embryos of one whorl to the adult; but in some adult individuals of *P. wesleyi* the lamella is very much reduced. This reduction does not indicate close relationship between *P. wesleyi* and *Planamastra*, since the process has been independent in the two forms. The immediate ancestors of *Pterodiscus wesleyi* doubtless had a well-developed columellar lamella, whereas in *Planamastra* the lamella was lost so long ago that no trace of it remains even in the embryonic stage.

All of the species of *Pterodiscus* usually plaster foreign matter, perhaps in part excrement, upon the shell, where it adheres chiefly at the periphery in form of an irregular flange. Some individuals are clean. Certain Amastras have the same peculiarity, but it has not been observed in *Planamastra* or *Armsia*. The shells of *Pterodiscus* are so thin that it is difficult to handle them without breaking.

This genus was first proposed under the name *Tropidoptera*

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by Mr. C. F. Ancey, who placed it between *Sitala* and *Hyalinia*, assigning to it one species, *Helix alata* Pfr. This generic term being preoccupied, Pilsbry substituted the name *Pterodiscus*, transferring the group to the *Endodontidæ* as a subgenus of *Endodonta*. The type of *Pterodiscus* was stated to be *H. alata* Pfr., but the specimen so identified and figured by Pilsbry proved to be not the *alata* of Pfeiffer, but a new species which Mr. Sykes subsequently named *P. wesleyi*. Sykes raised *Pterodiscus* to generic rank in 1900; and in 1905 Pilsbry and Vanatta showed it to belong to the *Achatinellidæ* near *Amastra*. At the same time they created a group *Helicamastra*, which is now found to be superfluous. Professor Hyatt, in his MS. on *Amastrinæ* recognized *P. cookei* and *P. heliciformis* as representing a new genus allied to *Amastra*, but no other species was known to him. The following accounts of *Pterodiscus*, *Planamastra* and *Armsia* have therefore been prepared wholly by Pilsbry.

The embryonic shell has been fully described under *P. thaanumi* and *P. a. litus*.

Key to Species of Pterodiscus.

a. Species of Lanai.

b. Umbilicus one-sixth the diam. of shell. *P. alatus*, no. 1.

b^1. Umbilicus one-eighth the diam. *P. a. litus*, no. 1*a*.

a^1. Species of Oahu.

b. Spire flat, or convex with flattened apex.

c. Upper surface flat; umbilicus contained 5½ times in the diameter; periphery obtuse; 3.4x 10 mm.; Waianae. *P. discus*, no. 2.

c^1. Upper surface slightly convex; umbilicus contained 4 times in diam.; columellar lamella subobsolete; 3.5x8.2 mm.; Kalaikoa, Wahiawa. *P. wesleyi*, no. 3.

c^2. Similar but col. lam. distinct; Ewa. *P. w. ewaensis*, no. 3*a*.

c^3. Upper surface convex; umbilicus nearly 5 times

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in diam. of shell; col. lam. rather strong; 4.2x 9.7 mm., 4 whorls. Near Kaaawa.
P. thaanumi, no. 4.

c^4. Upper surface convex; umbilicus 6½ to 9 times in the diam. of shell; lamella weak; 6x11 to 4.5x10.5 mm., 4½ whorls. Nuuanu.
P. cookei, no. 6.

c^5. Spire very low; umbilicus moderate; lamella rather strong; 14.5x4 mm., 5 whorls. Konahuanui. *P. rex*, no. 5.

b^1. Spire widely conic; whorls 5, the last carinate; umbilicus contained 5 times in the diameter; Waianae.
P. heliciformis, no. 7.

1. P. ALATUS (Pfeiffer). Pl. 22, figs. 1-3.

"Shell narrowly umbilicate, depressed, membranaceous, obliquely irregularly striate, having an oily luster, pellucid, brownish-corneous. Spire nearly flat. Whorls 3½, rapidly increasing, the last angular, encircled with a thin, deciduous wing-like carina, dilated in front. Base convex. Aperture very oblique, securiform. Peristome simple, unexpanded, the basal margin very deeply arcuate. Alt. 3, greater diam. 8½, lesser 6 mm." (*Pfr.*)

Lanai (Newcomb). Mountains behind Koele (Perkins).

Helix alata PFR., P. Z. S. 1856, p. 33; Monographia Hel. Viv. iv, p. 116.—*Amastra* (*Kauaia*) *alata* Pfr., SYKES, Fauna Hawaiiensis, Mollusca, p. 355. — *Amastra* (*Helicamastra*) *alata* Pfr., PILSBRY and VANATTA, Proc. A. N. S. Phila. 1905, p. 571, pl. 38, f. 4-6.

Mr. E. R. Sykes who examined the type of this species writes: "this shell has a columellar plait. It is, in my opinion, not a Helicoid at all, but belongs to an aberrant group of *Amastra*. The columellar plait does not ascend rapidly into the shell, but stands almost horizontally, and has no final knob."

The specimen described below and figured on plate 22, is from Newcomb's collection, and since Pfeiffer's types

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were from Newcomb, it may be inferred that they were from the same lot. In view of Dr. Pfeiffer's well-known accuracy as a diagnostician, it is hard to believe that his description of *Helix alata* was based upon the same species, since it disagrees in the number of whorls and shape of the spire, and in omitting a reference to the columellar lamella.

The shell, in Newcomb's specimen (pl. 22, figs. 1-3), is thin, umbilicate, biconvex, the base more convex than the spire, periphery carinate. Brown, nearly lusterless. Whorls 4, the first nearly smooth, hardly convex, the second flat, obliquely striate, with a peripheral marginal cord, the next whorl densely marked with growth-striæ, convex near the periphery but without a margining cord. Last whorl barely convex, sloping above, densely marked with growth-striæ and on its later portion with some coarse oblique wrinkles; convex beneath. Umbilicus rather narrow and tubular, its width contained about 6 times in the diameter of the shell. Aperture wider than high, the dilated columellar lip bearing an acute, subhorizontal lamella. Alt. 4.3, diam. 8.2 mm.

The peristome is broken in the specimen figured, which has no wing of foreign material adhering to the periphery.

1*a*. P. ALATUS LITUS n. subsp. Pl. 22, figs. 4, 5, 6.

The shell is lens-shaped, the base usually more convex than the top, keeled, thin and fragile, dull, brown. The whorls are flat above; the first half of the second whorl is margined above, as usual. Sculpture of very fine, close, retractive striæ, and on the last whorl some coarse wrinkles in the same direction. The base is somewhat convex, not strongly angular around the umbilicus. It is more or less copiously smeared with dirt, which at the periphery forms an irregular flange. The umbilicus is very narrow, tubular, about one-eighth the diameter of the shell. Columellar margin dilated, thickened within in adults, and bearing a strong, subhorizontal lamella.

Alt. 4.7, diam. 10 mm.; whorls 3¾. (no peripheral flange).

Alt. 4.3, diam. including flange 11.5 mm.

Alt. 5, diam. 9.5 mm. (no peripheral flange).

Lanai (D. Thaanum). Types 94501 A. N. S. P.

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The umbilicus is decidedly narrower than in Dr. Newcomb's specimens of *H. alata*. The embryonic shell when fully developed is 2.5 mm. in diameter, with about 1¾ whorls. The first whorl is slightly convex, smooth except for a dense microscopic crinkling or shriveling of the cuticle; the next whorl is radially rather coarsely striate. There is no appearance of spiral striation due to revolving bands of microscopic wrinkles, such as is seen in *P. thaanumi*.

2. P. DISCUS (Pilsbry & Vanatta). Pl. 22, figs. 7, 8, 9.

Shell thin and fragile, openly umbilicate, flat above, convex below, the periphery carinate, the keel obtuse. Uniform dull brown. Whorls nearly 4, the first hardly convex, marked with faint growth-lines; second whorl flat, weakly marked with oblique growth-lines, its outer edge distinctly margined, cord-like. The next whorl is slightly convex, without a peripheral cord or margin, and has rather rude wrinkled striæ. The last whorl becomes more swollen above, in part rising above the level of the preceding whorls, and is rather rudely wrinkled. The angular periphery is on a level with the flat spire. The umbilicus is deep and subcylindric. The aperture is oblique, wider than high; outer and basal margins thin and simple, columellar margin dilated, bearing an acute, subhorizontal white lamella. Alt. 3.4, diam. 10 mm.

Waianae, Oahu. Types No. 58,158, A. N. S. P., received from D. D. Baldwin.

Amastra (*Helicamastra*) *discus* PILS. & VAN., Proc. A. N. S. Phila. 1905, p. 571, pl. 38, f. 1-3.

This curious snail differs from *P. alatus* by its flat spire, irregular growth and larger umbilicus. It is much more depressed than *P. heliciformis* Anc., with fewer whorls.

Pterodiscus rex Sykes is a larger species with peripheral appendages as in *Pterodiscus wesleyi*. It seems to have a much smaller umbilicus than *P. discus*, but neither the description nor figure are clear on this point.

3. P. WESLEYI (Sykes). Pl. 23, figs. 1-5, 9.

Shell umbilicate, thin, flat above, convex beneath, carinated

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peripherally, brown with some irregular yellowish streaks, nearly lusterless. Whorls 3½, the first perceptibly convex at the beginning, soon becoming flattened, the first half of the second whorl a little impressed above the suture, which thus appears margined for a short distance. It is sculptured with very fine oblique growth striæ, with some coarser wrinkles on the last whorl. Last whorl is rather bluntly carinated, the keel on the last half whorl bearing an irregular flange or "wing" of adhering earth; base convex, obtusely angular around the tubular umbilicus. Aperture oblique, much wider than high, the lip thin and simple, the columellar margin dilated, bearing a very low, indistinct spiral ridge in the middle. This ridge is in the substance of the shell, and is hardly perceptibly thickened by callous deposit. Alt. 3, diam. 8 mm.

Kalaikoa, Oahu (D. D. Baldwin). Type No. 58,159, A. N. S. P. Ewa (C. M. Cooke); Wahiawa (D. Thaanum).

Endodonta (*Pterodiscus*) *alata* Pfr., PILSBRY, Manual of Conch., ix, p. 36, pl. 4, fig. 44 (no specific description or measurements). — *Endodonta* (*Pterodiscus*) *wesleyi* SYKES, Proc. Mal. Soc. Lond., ii, p. 127, 1896, based upon preceding reference.—*Pterodiscus wesleyi* SYKES, Fauna Hawaiiensis, Moll., p. 292.—PILSBRY & VANATTA, Proc. A. N. S. Phila. 1905, p. 573, pl. 39, f. 7, 8, 9.

This shell agrees well with Pfeiffer's description of *Helix alata*; but as the British Museum specimens under the name *alata* and those in the Newcomb collection have the columella strongly lamellate, it has been held by Mr. Sykes that Pfeiffer overlooked the lamella. At all events, *alata* is certainly from Lanai, where it has been taken also by Mr. Perkins. Named in honor of Dr. Wesley Newcomb.

The type specimen is fully described above and illustrated on pl. 23, fig. 9. It is evidently not quite adult. The very low columellar ridge or incipient lamella was overlooked in former accounts of the species.

Specimens from Wahiawa, Oahu, collected by Mr. Thaanum, pl. 23, figs. 1 to 5, are typical, and being fully adult they show the characters better than the type. The shell is red-

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dish-brown with some yellowish streaks along the wrinkles, which are quite coarse on the last whorl. The periphery may be either clean or heavily loaded with foreign material. The outline of the base is slightly convex, and it is distinctly angular around the umbilicus, which is one-fourth the total diameter. The columellar lamella is excessively weak and brownish in even fully adult shells. Its position is indicated inside the umbilicus by a slight furrow. A clean adult measures: alt. 3.5, diam. 8.2 mm.; whorls 4.

3*a*. *P. wesleyi ewaensis*, n. subsp. Pl. 23, fig. 10.

The form from Ewa in the C. M. Cooke collection, is practically typical in shape and sculpture, but the columellar lamella is decidedly stronger, being distinct and whitish.

In the type of *wesleyi* the columellar lamella is represented only by a very inconspicuous ridge hardly noticeable.

4. P. THAANUMI n. sp. Pl. 24, figs. 1, 2.

The shell is lens-shaped, umbilicate, the umbilicus contained nearly 5 times in the diameter of the shell, fragile, but slightly shining, dull brown, with sculpture of fine retractive striæ and on the last whorl some coarse wrinkles. Whorls 4, the second with a margin above the suture, the first two flat, the rest nearly so; last whorl carinate, convex beneath, not distinctly angular around the umbilicus. Peristome fragile; columellar margin dilated. Columellar lamella thin but rather strong, sloping slightly downwards, becoming very weak on the dilation of the lip. Alt. 4.2, diam. 9.7 mm.

Oahu: Kukaeiole, near Kaaawa, on the northeastern coast (D. Thaanum); type no. 95045 A. N. S. P.

This species has a narrower umbilicus than *P. wesleyi*, but wider than in *P. rex* or *P. cookei*. It is less angular around the umbilicus, the base not rising so high there. The columellar lamella is stronger than in *P. wesleyi*.

The embryo (pl. 25, figs. 1, 2, 3) is about 2.6 mm. in diameter, with 1¾ whorls. The first has microscopic crinkling of the cuticle as noticed in *P. alatus litus*, but the striæ on the second whorl are finer than in that form. There is an

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appearance of spiral striation, produced by spiral bands of microscopic, radially arranged wrinkles, visible on the last part of the first whorl, and the first half of the second.

5. P. REX (Sykes). Pl. 24, figs. 7, 8.

"Shell much depressed, heliciform; umbilicus deep, of moderate size; dark horn-color, strongly rugosely striated, with a fairly large protoconch; whorls five, increasing regularly, plano-convex, the suture being impressed and well marked; the last whorl is carinate, flattened above and somewhat inflated at the base; at the periphery the periostracum is exaggerated into a produced layer, from which projections in the shape of arrow-heads arise at right angles to the periphery; mouth subquadrate, with the lip hardly thickened and not reflected; columellar plait fairly strong and horizontal. Diam. maj. (with the peripheral wing) 14.5, alt. 4 mm." (*Sykes*).

Summit of Konahuanui, Oahu, Hawaiian Islands, amongst dead leaves and moss. This very interesting shell was collected by Mr. Ernest Lyman, and was kindly sent to me by Prof. H. W. Henshaw.

Amastra (*Kauaia*) *rex* SYKES, Annals and Magazine of Natural History, ser. 7, vol. xiv, August, 1904, p. 159, woodcuts.

"It somewhat recalls in form and appearance the well-known *Helicina agglutinans*, the periostracum covering the shell and being produced into an uneven wing at the periphery, some of the projections extending to 2 mm. from the shell. The species belongs to the group of *Amastra alata*, Pfr., and *A. heliciformis*, Ancey; from the latter, which is also an Oahu shell, it may readily be separated, in addition to its greater size and remarkable development of periostracum, by its more depressed form and smaller (proportionally) umbilical area." (*Sykes*).

A form which seems probably referable to *P. rex* was taken by Mr. D. Thaanum in Kalihi, a valley west of Nuuanu. The umbilicus is much smaller than in *P. wesleyi*, contained about 6½ times in the diameter, angular at its opening, conic

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within. The second whorl is weakly or distinctly margined above the suture. The striation is very fine and close, without coarse wrinkles. Columellar lamella is well developed and horizontal. Some specimens have a flat wing with triangular processes built out upon the peripheral keel. Alt. 3.5, diam. 9 mm., with 3½ whorls.

6. P. COOKEI Hyatt & Pilsbry, n. sp. Pl. 23, figs. 6, 7, 8.

The shells are *exceedingly thin and fragile*, narrowly umbilicate, the umbilicus contained 6½ to 9 times in the diameter of the shell; biconvex, sometimes incrusted at the periphery and umbilicus. It is dull brown, with sculpture of fine retractive striæ and coarse, low wrinkles in the same direction. The 4½ whorls are very slightly convex, the last angular at the periphery, convex beneath, not angular around the umbilicus. The suture is well impressed, but has *no margination above* on the second whorl. The columella is dilated, thin and paper-like, brownish. The columellar lamella is very weak on the dilated part of the columella, but inwardly it becomes somewhat stronger, though thin and bent downwards. Alt. 6, diam. 11 mm.; sometimes decidedly more depressed.

Oahu: Nuuanu valley (Cooke). Type in coll. C. M. Cooke.

This excessively fragile species is probably most closely related to *P. rex*, from an adjacent locality, but it seems to differ by the weaker columellar lamella and greater fragility. It is also less depressed, the lowest shell measuring about 4.5 x 10.5 mm., so far as can be ascertained in its broken condition. It is remarkable for the absence of margination above the suture on the second whorl, though there is a barely perceptible flattening in that region. Mr. Sykes does not mention whether the second whorl has a suprasutural margination in *P. rex*.

7. P. HELICIFORMIS (Ancey). Pl. 36, fig. 10.

"Shell heliciform, depressed, broadly umbilicate (the umbilicus open, deep, surrounded by an angle, about 2 mm. across), hardly shining, brown, wrinkle-striatulate, a little

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solid. Spire depressed, very widely conic, rather obtuse. Whorls 5, regularly increasing, a little convex, the suture impressed, last whorl carinate, convexly sloping above, convex beneath, slowly but not deeply descending for a long distance in front. Aperture oblique, armed with an acute revolving simple columellar lamella, emarginate, irregularly circular, angular outwardly, the base rounded, margins remote, columellar margin straightly sloping, forming an angle with the basal margin. Greater diam. 10, lesser 9, alt. 6, alt. of aperture 3.5 mm." (*Ancey*).

Oahu: Waianae (Baldwin).

Amastra heliciformis ANCEY, Bull. Soc. Malac. France, vii, 1890, p. 340.—THWING, Occas. Pap. B. P. B. Mus., iii, no. 1, p. 162, pl. 3, f. 17 (?).

"This *Amastra* is quite lens-shaped and Heliciform, but it is to be grouped as an extreme form, allied to *A. kauaiensis, agglutinans* and *sphærica*" (*Ancey*).

Not seen by Pilsbry, but Hyatt prepared the following notes from specimens submitted by Mr. D. D. Baldwin:

This extraordinary helix-like form has a large open umbilicus and depressed spire, with a strong angulated border to the umbilicus and coarse but regular striæ of growth; the spire even in the extreme young has a very wide angle. The subangulation of the whorl is broad or truncated or with angulated edges, and may have longitudinal ridges both on its flattened ridge and accompanying it on the sides. This appears late in life of the shell and persists, as in *Amastra cyclostoma*, throughout life, to a late stage. The spire is more elevated and more carinated than in the shells collected by Mr. Cooke and described as *Pterodiscus cookei*. The calcareous layer, in the three shells received from Mr. Baldwin, is deficient in large part, so that it is difficult to handle them. The form, columella, the plication or tooth, and the young, show that this is an ally of *Amastra spherica*. Mr. Baldwin kindly states in a letter that the shells so far collected by him are free from agglutinations.

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MANUAL

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WITH ILLUSTRATIONS OF THE SPECIES

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CONTINUED BY

HENRY A. PILSBRY, SC.D.,

SPECIAL CURATOR DEPARTMENT OF MOLLUSCA, ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

Part 63 Plain

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AUG 2[illegible] 1911

Genus PLANAMASTRA nov.

Amastrinæ of discoidal shape, with flattened embryonic whorls, like those of *Pterodiscus*, the umbilicus very broadly open. Peristome unexpanded, the columellar margin dilated, *without a columellar lamella* at any stage of growth. Viviparous.

Type: *P. digonophora*. Distribution: Oahu.

The jaw of *P. digonophora* is very thin, deeply arcuate, smooth except for a few wide plaits or flat ribs in the median part.

Teeth of *P. digonophora*.

The radula of *P. digonophora* has 11, 7, 1, 7, 11 teeth. Those of the median field stand in nearly straight transverse rows, but at the sides the rows of marginal teeth bend rapidly forward. The centrals are narrow, less than half the width of the adjacent lateral teeth, and bear a single small cusp. The lateral teeth are square, bicuspid with a large mesocone and small ectocone as usual. The marginal teeth are short and broad, with the mesocone oblique, and the ectocone split into two, three or four minute, acute denticles.

The embryonic shell of *P. digonophora* (pl. 25, figs. 4, 5, 6) is much smaller than in *Pterodiscus*, having a diameter of 1.8 mm. with 1¾ whorls. The top is like that of *Pterodiscus*, the first whorl being smooth except for some very faint radial ripples and a microscopic crinkling of the cuticle. On the second whorl the wrinkle-striation becomes coarser and retractive, and there are a few very faint spirals. The first whorl is slightly convex, the second flatter.

Planamastra and *Pterodiscus* have in common a flat-topped embryonic shell. They doubtless diverged from a common

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ancestor which had become differentiated from *Amastra* by this character; but while *Pterodiscus* retained the Amastroid columellar lamella, this was early lost in the *Planamastra* phylum, and no trace of it remains even in embryonic shells.

1. P. DIGONOPHORA (Ancey). Pl. 24, figs. 9, 10, 11.

"Shell depressed, sublenticular, scarcely shining, rather thin, opaque, very broadly umbilicate (the umbilicus conic, showing all the whorls, surrounded by a projecting angle, 4 mm. wide), irregularly, obliquely and rather roughly sculptured with growth-lines; chestnut brown. Spire flat. Whorls 4, rather rapidly increasing, flattened, separated by an impressed and simple suture; the last whorl having projecting angles above and around the umbilicus, flat above, conically tapering below the upper angle, not descending in front or very gradually descending. Aperture somewhat oblique, somewhat ax-shaped, biangulate outwardly; peristome acute, the margins joined by a very thin callus. Alt. 2¼, diam. maj. 6½, min. 5½ mm." (*Ancey*).

Oahu: Waianae (Baldwin).

Patula digonophora ANCEY, Bull. Soc. Malac. France vi, 1889, p. 171. — *Pterodiscus digonophorus* Anc., SYKES, Fauna Hawaiiensis p. 292.

In this species the upper surface resembles that of normal forms of *Pterodiscus*, the embryonic sculpture being similar, the second whorl more or less distinctly marginate above the suture, and the periphery carinate. The lower surface differs by the very broadly open umbilicus and the absence of any trace of a columellar lamella at all stages of growth. The specimens figured were received from Mr. Baldwin. An adult measures, alt. 2.7, diam. 7 mm., whorls 3¾. The embryonic shell figured (pl. 25, figs. 4-6) has a diameter of 1.8 mm. with 1¾ whorls.

2. P. PEASEANA n. sp. Pl. 25, figs. 8, 9, 10.

The shell is discoidal, with very low, convex spire, openly umbilicate base, and acutely carinate periphery; thin; corneous, with a brown band revolving in the middle of the upper

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surface of the last whorl; slightly shining. Embryonic whorls apparently 1½, weakly convex, faintly marked with growth-striæ and on the latter part having a few delicate spiral raised lines and some very fine radial wrinkling. The next whorl is moderately convex, with sculpture of faint growth-lines and very minute, retractive corrugations, more oblique than the growth-lines. The last half whorl is rather coarsely, irregularly wrinkle-striate, and microscopically granulose. The base has irregular growth-lines, but very little microscopic sculpture. Whorls 3, the last acutely carinate at the periphery, convex below, very obtusely subangular near the umbilicus. Umbilicus extremely shallow and open, showing 2½ convex whorls. Aperture somewhat oblique the outer and basal margins of the peristome simple and sharp, columellar margin but slightly dilated, thin, unarmed. Alt. 1.7, diam. 4.9 mm.

Hawaiian Is. (Pease). Type 1984 coll. A. N. S. P.

Very unlike *P. digonophora* by its microscopic sculpture, more convex whorls, pale color with a band on the last whorl, and the very shallow umbilicus; yet I can find no other genus which would contain this snail. It may possibly be the *Helix depressiformis* of Pease, but in the collection of the Academy it was labelled "*H. alata*," and Pease makes no mention of a band on his species.

P. depressiformis (Pease).

"Shell discoidal, planorboid, planulate above, convex beneath, thin, subpellucid, a little shining, brownish-corneous, broadly umbilicate, obliquely closely rugose-striate. Spire planulate, sometimes a little elevated. Whorls 3½, slightly marginate, the last acutely carinate, at the margin compressed roundly carinated at the umbilicus. Alt. 2, diam. 7 mm." (*Pease*).

Islands of the Central Pacific (Pease).

Helix depressiformis Pse., Proc. Zool. Soc. London 1864, p. 670, no. 8.

This species and the next were apparently based upon forms of *Planamastra*. Both were described from the "Cen-

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tral Pacific Islands," and neither has been figured or seen by any subsequent author. Mr. Sykes did not find them in the British Museum collection; they are not in the collections at Philadelphia or Washington, nor is any trace of them to be found in the Pease collection at Cambridge, Massachusetts. We learn from labels in the Academy collection that Andrew Garrett knew them not. It must be admitted that the diagnoses are insufficient for positive identification; and in the absence of types, the names may be regarded as defunct.

P. prostrata Pease.

"Shell thin, depressed, deeply umbilicate, greenish-corneous, decussated with close and very fine striæ. Whorls 4, flat, rapidly increasing, the last wider, acutely angular, grooved near the margin above, dilated in front, convex beneath, apex depressed. Aperture widely rotund-lunar; peristome simple, acute. Alt. 2¼, diam. 6 mm." (*Pse.*)

Islands of the central Pacific (Pease); Lanai? (Pease).

Helix prostrata Pse., P. Zool. Soc. 1864, p. 670, no. 9; P. Z. S. 1871, p. 475.

Genus ARMSIA, n. gen.

Amastrinæ with the shape of *Gonyodiscus*, very broadly umbilicate, the *embryonic whorls convex, projecting,* and spirally striate, the *peristome well expanded,* thin, and *without a columellar lamella.* Type *A. petasus.*

This group differs from all forms of *Pterodiscus* and *Planamastra* by the decided *convexity* of the projecting embryonic whorls and the stronger expansion of the peristome. Like *Planamastra* it lacks trace of a columellar lamella. I have not seen the embryo except as exposed in grown shells, but it must differ markedly from that of *Pterodiscus* and *Planamastra.* The embryonic whorls are worn in the shells examined, but in places they show rather coarse spiral striæ, which are wanting on the radially costate later whorls (pl. 25, fig. 7). The soft anatomy is unknown. It is probably viviparous, like the related genera.

While evidently related to *Planamastra, Armsia* has

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been diversely differentiated, and probably represents a parallel phylum derived from the same Amastrine stock before the spire had become flat.

This genus is dedicated to Mrs. J. M. Arms Sheldon whose assistance has enabled us to illustrate the Achatinellidæ more fully than would otherwise have been possible.

1. A. PETASUS (Ancey). Pl. 24, figs. 3, 4, 5, 6.

"Shell very broadly and perspectively umbilicate, sublenticular, thin, buff-brown, uniform, slightly shining, rudely and closely rugose-striate, the striæ lamellose. Spire broadly conoidal, the sides somewhat concave, summit projecting a little, rather obtuse. Whorls 5, nearly flat, separated by a linear and not very deep suture, regularly increasing, the last provided with an acute carina above and another below around the umbilicus, hardly descending, somewhat sloping above, inversely conic and flat below the principal carina. Umbilicus saucer-shaped, conic. Aperture nearly vertical, ax-shaped, acutely angular on the right, more obtusely below, toothless. Peristome simple, unexpanded, the margins remote. Alt. 2.2, diam. maj. 4.33, min. 3.75 mm." (*Ancey*).

Oahu: Waianae Mountains (Baldwin).

Pterodiscus petasus ANCEY, Proc. Malac. Soc. London iii, July, 1899, p. 268, pl. 12, f. 4.—PILS. & VAN., Proc. A. N. S. Phila. 1905, p. 574, pl. 38, f. 7, 8.

Easily known by its bicarinate body-whorl, low-conic spire and very broadly conic umbilicus. The shell described and figured by Mr. Ancey (fig. 6) was not mature. Adult shells have the outer, basal and columellar margins of the lip broadly expanded, the revolving angles of the last whorl becoming obsolete upon it. The last third or fourth of the last whorl descends rather deeply. Shells measure from alt. 3, diam. 4.8 mm. to alt. 3.5, diam. 5.8 mm.

Genus AMASTRA H. & A. Adams.

Amastra ADS., Genera of Recent Mollusca, ii, p. 137 (Feb., 1855).—PEASE, P. Z. S. 1869, p. 649.—GULICK, P. Z. S. 1873, p. 91, type *A. magna*.

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Shell usually dextral, varying from globose-conic to oblong-conic; umbilicate or imperforate; dull or dark colored, or light with a dull, darker or yellowish cuticle; whorls 5½ to 8; spire and apex conic. Aperture ovate, the outer lip not expanded, often thickened within; columella bearing a spiral lamella which penetrates *about a half whorl*, but is present at all stages of growth examined; above it the axis is slightly sinuous. Viviparous, jaw vertically striate, teeth in nearly straight transverse rows, of the usual quadrate form, the centrals narrow with small cusp.

Type: *A. magna* C. B. Ad. Distribution: Kauai, Oahu, Lanai, Molokai, Maui and Hawaii; living on the ground under leaves, etc., or rarely on ferns and low bushes, in the mountain forests.

Amastra, as constituted by H. & A. Adams, 1855, was a homogeneous group, comprising the species *baldwini* Newc., *biplicata* Newc., *ellipsoidea* Gld., *gigantea* Newc., *magna* C. B. Ad., *melampoides* Pfr., *moesta* Newc., *nucleola* Gld., *obesa* Newc., *obscura* Newc., *reticulata* Newc., *tristis* Fér., *ventulus* Fér., *violacea* Newc. In *Die Heliceen*, 1860, von Martens distributed the species in *Laminella* and *Leptachatina*, ignoring *Amastra*. Pease, 1869, gave a classified list of species in which several natural groups within the genus were recognized. Gulick, in 1873, selected *A. magna* as the type of Amastra.

Amastra differs from the more primitive genus *Leptachatina* by its more conic apex, that of *Leptachatina* being rounded. The shell is generally duller, often with a partially deciduous outer cuticle, wanting in *Leptachatina*, and it differs more fundamentally by the viviparous reproduction. *Carelia* is closely related to *Amastra*, young shells of some species being quite Amastriform; but the adult stage is more lengthened and columnar, and the jaw is said to be ribbed. The relationship between *Amastra* and *Laminella* is very intimate; indeed the two groups are separated generically in this work more as a matter of convenience than for any important structural character known to exist, though they are no doubt natural groups. If consolidated into one genus,

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the name *Laminella* would take precedence over *Amastra* for the group so formed.

Characteristics of Amastra.

THE COLUMELLAR LAMELLA is present from the later embryonic stages. How early it appears we do not know, but in half-grown embryos examined it is either distinct or represented by a spiral cord. It is absorbed as growth proceeds, leaving the remaining portion about a half-whorl long. Very rarely, in old shells, the lamella is wanting, without other evidence of abnormality in the shell. Two instances have been noted, *A. violacea wailauensis*, pl. 39, fig. 13, and *A. læva*, pl. 48, fig. 15. The lamella is subhorizontal or bent downwards in most Metamastræ. It is small and oblique in *Amastrella, Cyclamastra* and *Carelia*.

In some forms of *Amastra* the columellar lamella is doubled, or rather, there is a second fold developed above the usual lamella. This structure is usual in the *biplicata* series of Lanai, and it occurs as an occasional mutation in the *Spirizona* series of Oahu. A similar duplication of the columellar lamella exists in *Leptachatina leucochila* Gulick (p. 73). In a few species of various groups there is a low callous lump on the parietal wall a short distance within, not sufficiently definite to be called a tooth, and so far as we know rather rarely developed in any species. It has been noted in *A. decorticata* (pl. 33, fig. 7), *A. antiqua, A. violacea* and *A. knudseni*.

THE CUTICLE, in primitive species, such as the Kauaian and Hawaiian Amastrellas, is thin and pale yellowish. In many species of Oahu, Molokai, Lanai and Maui the outer layer is dark, usually dull, and more or less completely deciduous, always transient in front of the aperture, exposing the thin, closely adherent and glossy inner layer, which is generally of a different color and lighter shade. The outer cuticle is frequently mottled or marked with zigzag streaks in species of Lanai, Molokai and Maui, somewhat as in *Laminella*; but in other islands it is plain or varied with streaks along growth-lines. The inner cuticle is transparent, show-

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ing the color of the underlying calcareous layer modified by its own tint.

EMBRYONIC SHELL:—The sculpture and, to a less degree, the shape of the embryonic whorls is remarkably varied. In the more primitive forms of *Amastrella* these whorls are convex and almost smooth, showing very faint growth-lines only. In *A. tristis* the whorls are flattened, and either striate or weakly costate longitudinally; while in most *Amastræ* of Molokai and Maui the embryonic whorls are flat, strongly costate, and carinate above the suture. Some species, as *A. nigra* (pl. 43, figs. 1-3) and others, have costate and carinate embryonic whorls in some individuals, while in others they are more convex and striate; the neanic and adult characters being alike. This is apparently a case where the larval form mutates independently of the adult. Similar conditions have been observed by Sturany and others in marine Prosobranchs; but in pulmonate snails no such diversity of the embryo has come under observation except in this genus. Such diversity of embryo with identity of later stages has been observed by both authors in a number of species. It should be remembered in this connection that embryo shells frequently vary in color, quite independently of the later stages, which may be similar in individuals having diversely colored embryonic shells.

Subgenera and Sections of Amastra.

a. Shell umbilicate; embryonic whorls smooth. *Cyclamastra.*

*a*¹. Shell perforate, rimate or imperforate (or in some *Amastrellæ* umbilicate, the embryonic whorls striate).

b. Last whorl strongly carinate; shell large and dark.

c. Last whorl with a peripheral carina. *Kauaia.*

*c*¹. Last whorl with two ridges or carinæ. *Armiella.*

b¹. Last whorl not conspicuously carinate.

c. Embryonic whorls smooth or striate, not carinate; dextral (except *A. thaanumi*).

d. Cuticle thin, not figured; shell ovate. *Amastrella.*

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d^1. No dull or figured outer cuticle, but the shell often variegated; ovate or oblong. *Metamastra.*

d^1. Outer cuticle when present not figured; shell turrited or pyramidal. *Paramastra.*

c^1. Embryonic whorls generally costate and carinate, flat; outer cuticle frequently mottled or figured with angular lines; shell ovate or oblong-conic, dextral. *Amastra.*

c^2. Embryonic whorls delicately costulate; shell sinistral, dark or dull colored, without zigzag lines or spots. *Heteramastra.*

Arrangement of Species.

The Amastræ are grouped by islands in the descriptive text of this work, as a more convenient arrangement than one strictly natural. This plan often separates forms closely related; therefore a classified list is given below. This classification differs in some important details from that of Professor Hyatt's manuscript. This would not be especially significant were it not that the systematic relationships of the forms affect fundamentally our zoogeographic conceptions. It has therefore been deemed necessary to give in full the senior author's classification, with his deductions regarding the migrations of the several groups. See Appendix B.

Systematic List of Amastræ.

Genus AMASTRA H. & A. Adams.

Subgenus KAUAIA Sykes.

A. kauaiensis Newc. Kauai.

Section ARMIELLA Hyatt.

A. knudseni Bald. Kauai.

Subgenus CYCLAMASTRA Pils. & Van.

[The genera *Pterodiscus, Planamastra* and *Armsia* are tangents of this group.]

(*Sphaerica Series.*)

A. cyclostoma Bald. Kauai. A. obesa Newc. Maui.

A. sphærica Pease. Kauai. A. agglutinans Newc. Maui.

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(*Umbilicata Series.*)

A. similaris Pease. Kauai.
A. antiqua Bald. Oahu.
A. sola Pils. Oahu.
A. extincta Pfr. Oahu.
A. hartmani 'Nc.' Hartm. Oahu.
A. morticina Pils. Maui.
A. umbilicata Pfr. Molokai.

Subgenus AMASTRA H. & A. Ad.

Section AMASTRELLA Sykes.

(*Rugulosa Series.* Kauai.)

A. rugulosa Pease.
A. r. normalis Pils.
A. nucleola Gld.
A. anthonii Newc.

(*Inflata Series.* Oahu.)

[Note:—Species from the Waianae range are followed by W.]

A. rubens Gld. W.
A. r. corneiformis Hy. & P. W.
A. r. castanea Pils. W.
A. r. kahana Pils.
A. r. infelix Pils.
A. seminigra Hy. & Pils.
A. tenuilabris Gul.
A. t. rubicunda Bald.
A. luctuosa Pfr.
A. l. sulphurea Anc.
A. decorticata Gul.
A. inflata Pfr.
A. rubida Gul.
A. elliptica Gul.
A. tristis Fér.
A. porcus Pils. W.

(*Petricola Series.* Molokai.)

A. petricola Newc.
A. abavus Pils.

(*Flavescens Series.* Hawaii.)

A. flavescens Newc.
A. f. saxicola Bald.
A. f. henshawi Bald.
A. hawaiensis Hy. & Pils.
A. luteola Fér. (?)

(*Melanosis Series.* Hawaii.)

A. senilis Bald.
A. melanosis Newc.
A. conica Bald.
A. c. gyrans Hyatt.
A. c. kohalensis Pils.
A. fossilis Bald.

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Section METAMASTRA Hyatt & Pilsbry (type *A. reticulata*).

(*Reticulata Series.* Oahu.)

[Note:—Species from the Waianae range are followed by W.]

A. textilis Fér.
A. t. media Hy. & Pils.
A. t. kaipaupauensis Pils.
A. gulickiana Pils.
A. spaldingi Cooke.
A. pellucida Bald. W.
A. breviata Bald.
A. irwiniana Cooke.
A. albolabris Newc. W., E.
A. subrostrata Pfr.
A. sericea Pfr.
A. davisiana Cooke.
A. thaanumi Pils.
A. solida Pse.
A. vetusta Bald.
A. reticulata Newc. W.
A. r. conspersa Pfr. W.(?)
A. r. dispersa Hy. & Pils. W.
A. r. orientalis Hy. & Pils.
A. r. errans Hy. & Pils.
A. cookei Pils.
A. transversalis Pfr.
A. caputadamantis Pils.
A. undata Bald.
A. badia Bald.

(*Cornea Series.* Oahu.)

A. cornea Newc. W.
A. crassilabrum Newc. W.
A. subcornea Hy. & Pils.
A. æmulator Pils.

Section PARAMASTRA Hyatt & Pilsbry (type *A. spirizona*).

A. micans Pfr. W.
A. frosti Anc. W.
A. tenuispira Bald. W.
A. turritella Fér.
A. t. aiea Pils.
A. t. waiawa Pils.
A. spirizona Fér. W.
A. s. nigrolabris Sm.
A. spirizona rudis Pfr.
A. s. chlorotica Pfr.
A. intermedia Newc. W.
A. porphyrea Newc. W., E.
A. porphyrostoma Pease.
A. cylindrica Newc.
A. variegata Pfr.

Section AMASTRA s. str.

(*Biplicata Series.*)

A. biplicata Newc. Lanai.
A. durandi Anc. Lanai.
A. moesta Newc. Lanai.
A. moesta obscura Nc. Lanai.
A. m. longa Sykes. Lanai.
A. humilis Newc. Molokai.

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(*Magna Series.*)

(Lanai.)	(Molokai.)
A. magna C. B. Ad.	A. violacea Newc.
A. m. balteata Pils.	A. v. wailauensis Pils.
A. aurostoma Bald.	A. nubilosa Migh.
A. grayana Pfr.	A. n. macerata Hy. & Pils.
A. rubristoma Bald.	

(*Nucula Subseries.* Lanai.)

A. nucula Smith.

(*Pullata Subseries.* Molokai.)

A. pullata Bald.	A. seminuda Bald.
A. p. subnigra Hy. & Pils.	A. uniplicata Hartm.
A. p. umbrosa Bald.	

(*Nigra Subseries.* Maui.)

A. baldwiniana Pils.	A. makawaoensis Pils.
A. nigra Newc.	A. mastersi Newc.
A. subcrassilabris Hy. & Pils.	

(*Assimilis Series.*)

(Molokai.)	(Maui.)
A. mucronata Newc.	A. affinis Newc.
A. m. simularis Hartm.	A. a. pupoidea Newc.
A. m. roseotincta Sykes.	A. a. bigener Hyatt.
A. m. citrea Sykes.	A. a. cinderella Hyatt.
A. m. semicarnea Anc.	A. a. kaupakaluana Pils.
A. m. atroflava Pils.	A. nana Bald.
A. sykesi Pils.	A. malleata Sm.
A. nubifera Hy. & Pils.	A. conifera Sm.
A. n. dissimiliceps Pils.	A. johnsoni Hy. & Pils.
A. modesta C. B. Ad.	A. erecta Pse.
A. m. dimissa Pils.	A. assimilis Newc.
A. subobscura Hy. & Pils.	A. montana Bald.

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(*Pusilla Series.*)

A. pusilla Nc. Lanai.
A. tricincta Pils. Molokai.
A. elegantula H. & P. Molokai.

Section HETERAMASTRA Pils. (type *A. hutchinsonii*).

A. elongata Newc. Oahu?
A. fraterna Sykes. Lanai.
A. soror Newc. Maui.
A. s. interjecta H. & P. Maui.
A. s. laticeps Pils. Maui.
A. subsoror Hy. & Pils. Maui.
A. læva Bald. Maui.
A. perversa Pils. Molokai.
A. hutchinsonii Pse. Molokai and Maui.
A. farcimen Pfr. Maui.
A. sinistrorsa Bald. Hawaii.

(*Sedis incertæ.*)

A. amicta Smith.
A. luteola Fér.
A. peasei Smith.
A. lineolata Newc.

AMASTRÆ OF KAUAI.

In Kauai forest covers the mountains of the central mass, extending down to about 1,200 feet on the windward (northeast) slope, and 1,500 feet on the leeward slope. Near the coasts shells are very abundant in Pleistocene or later deposits, some species being known only from these fossil examples. We do not know that central Kauai around Mount Waialeala has been explored. Large additions will probably be made to the Leptachatinæ and Amastræ when the island is adequately searched.

Niihau is said to be practically all grass-land, a single *Carelia* being found fossil. No doubt further search will result in numerous other land shells on this island, in Pleistocene deposits.

Kauai, while poor in species, possesses some of the most remarkable *Amastrinæ*, such as *Carelia, Armiella* and *Kauaia.* All of them have probably descended from ancestral forms of *Amastrella* and *Cyclamastra*, which with *Leptachatina* seem to have constituted the entire primitive Achatinellid fauna of the island.

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Key to Amastræ of Kauai.

a. Shell imperforate, large, strongly carinate (*Kauaia*).

b. Trochiform, solid, peripheral carina dominating. *A. kauaiensis*, no. 1.

*b*¹. Oblong-conic, the last whorl with two carinæ. *A. knudseni*, no. 2.

*a*¹. Shell umbilicate (*Cyclamastra*).

b. Periphery carinate; shell wider than high, conic above, convex below. *A. cyclostoma*, no. 3.

b. Periphery rounded.

c. Globose-conic, diam. and alt. subequal. *A. sphærica*, no. 4.

*c*¹. Ovate-conic, much longer than wide. *A. similaris*, no. 5.

*a*². Shell rimate or imperforate, ovate-conic, white behind the lip and around the axis (*Amastrella*).

b. Fine spiral lines on the later whorls. *A. anthonii*, no. 8.

*b.*¹ Not spirally striate.

c. Larger, roughly striate, brown. *A. rugulosa*, no. 6.

*c*¹. Smaller, finely striate, purplish with brown spire and white sutural line. *A. nucleola*, no. 7.

Subgenus KAUAIA Sykes.

Carinella PFR., Novit. Conch., iv, 1875, p. 116, for *A. kauaiensis* only. Not *Carinella* Sowerby, 1839.—*Kauaia* SYKES, Fauna Hawaiiensis, ii, pt. iv, Mollusca, May 19, 1900, p. 355, same type.

Shell biconic or trochiform, carinated, solid, imperforate; dark brown, whitish around the axis, under a thin yellow cuticle. Embryonic whorls flattened, sculptured with low curved riblets, later whorls with spiral striæ. Internal axis tubular, contracted near the base in each whorl, in the last half-whorl bearing a small columellar lamella. Type *A. kauaiensis* Newc.

Kauaia resembles some specimens of *Amastrella tristis* in its

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conic, more or less ribbed embryonic whorls; also *Carelia* and typical *Amastra* (*magna* group) have similar embryos. In color and texture the adult shell resembles *Amastrella anthonii*, etc.; while the resemblance to *Cyclamastra* is discussed below. The possession of features belonging to several Amastran groups favors the view that *Kauaia* is an old form, little changed since it arose from the primitive Amastran stock.

"The resemblance between the neanic stages of *Kauaia kauaiensis* and the adults and older stages of *Cyclamastra cyclostoma* are visible in the flattened, carinated and rapidly spreading volutions of the young of *kauaiensis* through the first five volutions. After this the increase by growth is less rapid in the transverse diameter of the spire, and the outer or dorsal side begins to take on a different aspect. The contour becomes more or less curved and the spire more elongated owing to the greater increase of the vertical or dorsoventral diameters. Not only the form, but the open umbilicus at this stage, as well as the columella and aperture, are generically identical with those of *Cyclamastra*. Later the close columella and changes of form above described show a wider separation in structure. It is also obvious from the above that *Cyclamastra* is nearer to the forms from which *Kauaia kauaiensis* was derived than the full-grown shells of that species, and must therefore be looked upon as more primitive. The resemblances of the younger stages of *kauaiensis* to the full-grown stages of *C. cyclostoma* are not as strongly pronounced in some shells as in others, owing to the fact that the young have more elongated spires in some shells." (*Hyatt* MS.)

1. A. KAUAIENSIS (Newcomb). Pl. 16, figs. 1, 2, 3.

The shell is imperforate, dextral, trochiform, solid, carinate. The first whorl is smooth (worn in examples seen); the second is rather coarsely, arcuately ribbed; third whorl more finely ribbed; succeeding whorls are rudely obliquely wrinkle-striate. On the fourth whorl spiral sculpture appears, at first fine, later becoming rather coarse but very low spiral cords. The whorls are very strongly keeled, the keel appearing above

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the suture on the last 2 or 3 whorls, or concealed on all but the last whorl, on the latter half of which it becomes more prominent. Base convex. Whorls 6½, but slightly convex. Dull red-brown, becoming darker, purplish-brown at the apex, and paler, yellowish, at the base. There is a whitish border below the suture throughout. Aperture oblique, white within; outer lip thick; columella bearing a strong spiral fold below the middle.

Length 23.5, diam. 19 mm.

Length 23, diam. 17 mm.

Kauai: Halemanu (Baldwin); Makaweli at 2000 ft. and Halemanu at 4000 ft. (Perkins). Type in Newcomb coll.

Achatinella kauaiensis NEWC., Ann. Lyc. N. H. of N. Y., vii, 1860, p. 145; Amer. Journ. of Conch., ii, p. 209, pl. 13, f. 1.—PFR., Novit. Conch., iv, p. 115, pl. 126, f. 8, 9 and f. 10, 11 (embryo).—BALDWIN, Catalogue, p. 9.—*Amastra* (*Kauaia*) *k.*, SYKES, Fauna Hawaiiensis, p. 355.—*Helicter kauaiensis* PEASE, Journ. de Conchyl., xviii, 1870, p. 88.

The cuticle is thin and of a light brownish tint, the darker color being in the substance of the underlying shell. The embryonic shell figured by Pfeiffer is angular at the periphery and measures 7.5 mm. long. The specimens figured were received from Dr. Newcomb.

In some examples there is the weak indication of a carina at the shoulder, especially on the latter part of the last whorl. It is faintly shown in fig. 3. This character, which is only occasionally obvious, shows a relationship to *A. knudseni*, in which a stout ridge is developed in the same position.

"There are two types of the apex, one somewhat more pointed than the other, and with smoother and more shining horn-color due to the finer striæ of growth, and the dorsal outer sides are not strictly flat, slightly rounded, and maybe have a slight shoulder even on the first volution in some specimens. The striæ are not strictly parallel, but may be a little irregular. The other type has more regular fold-like longitudinal bands of growth from an early stage, and the dorsi of the volutions are flatter" (*Hyatt*).

The axis is tubular, the tube rather strongly contracted in

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each whorl near the lower partition, and widest where it joins the upper partition. Hence, until the shell is nearly mature there is an umbilical orifice behind the reflexed columellar lip; in the last whorl this becomes closed. In the last half-whorl a callous lamella is superposed upon the axis just above its basal contraction.

The shell is angular at the periphery in all post-embryonic stages of growth, but in the third or fourth whorl a projecting periferal keel appears, persisting to the aperture and becoming stronger with age. In the adult stage the aperture becomes smaller, especially narrower, than in shells younger by a whorl. Finally, senility is marked by the descent of the last whorl below the keel, and its further contraction laterally. These stigmata appear earlier in some shells than in others.

Pease collected this species at an elevation of about 4,500 ft. "The animal is very small in comparison with the size and thickness of the shell, a little larger than the diameter of the latter, and excessively narrow. It drags the heavy shell balanced on its back. When it crawls the head is stretched out as far as possible, the two ends of the body solidly fixed, until the middle part contracts and draws the shell forward."

Section ARMIELLA Hyatt.

At first sight this group appears to be obviously a modification of *Kauaia*, having an additional carination along the shoulder and a broad, flattened or concave zone evolved on the outer side of the volutions between the carinæ. But closer obervation develops the fact that the young probably resembles the young of *Carelia*, and then it is at once evident that the volutions with their peculiar angulations and obtuse spire are similar to the most primitive forms of *Carelia*. These are *C. bicolor* (pl. 16, fig. 7, neanic stage) and *C. adusta*, which change the least during their development, and in their ephebic stages are more like their own young than the more elongated species of *Carelia*. The present group is, therefore, regarded here as an offshoot of *Carelia* having a stouter spire and more pronounced bicarinate volutions than any species of *Carelia*. It is dedicated to Mrs. J. M. Arms Sheldon (*Hyatt, MS.*).

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Recognizing the affinity of *Carelia*, it must also be admitted that *A. knudseni* is closely related to *A. kauaiensis*, as Mr. Baldwin recognized.

2. A. KNUDSENI Baldwin. Pl. 16, figs. 4, 5, 6.

Shell imperforate, dextral, oblong-conic, bicarinate. The first 3½ whorls are slightly convex, forming a conic embryonic shell; the first whorl is smooth; the second has curved vertical riblets; on following whorls the riblets become irregular, frequently formed of two or more contiguous striæ. The first post-embryonic whorl has rather coarse wrinkles and minute, thread-like striæ, and some traces of spiral cords appear upon it. The surface at once becomes more convex, and then angular, forming a shoulder above the middle of the whorl; below this shoulder it is vertical. After the fifth whorl the characters of maturity appear; the whorl expands more rapidly, the angle gives place to a keel; on the last whorl a second (periferal) keel appears, the space between them being concave; the base is convex, and the whole surface sculptured with spiral cords and striæ. Color, purplish red-brown, darker towards the apex and on the base, having a pale border below the suture, extending to the apex, and more or less profusely marked with yellow on the carinæ, cords and folds of the last whorl.

The aperture is irregularly ovate, oblique, dark within, but having a bluish-pearly luster; outer lip regularly arcuate, scarcely modified by the carinæ. Columella short, concave above, obliquely truncate at the base, covered with a flesh-tinted callus, and bearing a very obliquely descending, thin, spiral lamella.

Length 33, diam. 19 mm. (Type, A. N. S. P.)

Length 34.5, diam. 19 mm. (Cooke coll.)

Kauai: Halemanu and Puukapele (A. Knudsen).

Amastra knudsenii BALDWIN, Proc. A. N. S. Phila., 1895, p. 234, pl. 11, f. 43, 44.—*Achatinella knudsenii* Newc., THWING, Orig. Descriptions, etc., pl. 3, f. 25.

The type specimen (fig. 4) is a rather thin shell, barely adult. With age the shell becomes thick and heavy. A ge-

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rontic specimen (pl. 16, fig. 6) in coll. C. M. Cooke is very solid, the outer wall thick, parietal wall covered with a thick white callus which bears a low, wide, conical prominence, a short distance within. The columella is heavily white-calloused, and its spiral lamella is thick, blunt, and hardly differentiated from the basal truncation of the pillar. The specimen is dead and almost wholly denuded of the thin yellow cuticle.

"The species is very rare. We dedicate it to Mr. A. Knudsen, the young naturalist who discovered it. He writes that it is of very limited distribution, being found far up the mountain only in an isolated tract of woodland which escaped the forest fires of twenty years ago. In three days' diligent search he found only twelve living examples" (*Baldwin*).

Subgenus CYCLAMASTRA Pilsbry & Vanatta.

Cyclamastra PILS. & VAN., Proc. A. N. S. Phila., 1905, p. 570; type *A. cyclostoma* Bald.

The shell is *deeply umbilicate* in all post-embryonic stages, varying in shape from biconic, somewhat Heliciform, to globose-conic or ovate-conic, the last whorl angular or rotund. Embryonic whorls with faint radial ripples or nearly smooth; later whorls brown under a thin brown or yellowish cuticle. Type *A. cyclostoma* Bald.

Cyclamastra occurs on all of the Hawaiian Islands except Niihau, Lanai and Hawaii. The open axis is evidently an old feature, characteristic of the neanic stage in *Kauaia*, etc. Nearly half of the known species are found only as fossils. The genera *Pterodiscus, Planamastra* and *Armsia* evidently had their source in *Cyclamastra*.

Series of A. sphærica.

Besides the following species, this group includes *A. obesa* and *A. agglutinans* (*carinata*) of the island of Maui.

3. A. CYCLOSTOMA Baldwin. Pl. 15, figs. 1, 2, 3, 6.

The shell is umbilicate, conic above, convex below the strong median peripheral carina; moderately solid; purplish-

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brown, becoming yellowish-brown on the latter part of the last whorl and around the umbilicus. Whorls 5½, weakly convex. The spire is conic with concave outlines; first half-whorl smooth, with a pale tip, then faint radial ripples appear, this sculpture continuing for three whorls. The last two whorls have sculpture of fine growth-striæ and indistinct, coarse, low wrinkles. Last whorl flattened above, convex below the stout peripheral carina, which becomes subobsolete near the aperture, which it does not modify in shape. Aperture oblique, ovate, flesh-colored within, but thickened with a white callus near the lip. Peristome obtuse, being a little thickened within, the columellar margin expanded, generally showing the end of a small spiral lamella which penetrates about a half whorl inward. Internal axis regularly tapering from below upward in each whorl, marked with low, pale, obliquely axial striæ or wrinkles (fig. 6).

Alt. 16.8, diam. 17.3 mm. (fig. 1).

Alt. 16, diam. 19 mm.

Alt. 16, diam. 18 mm. (figs. 2, 3).

Kauai: Makaweli (Judd, Miss Gay). Types no. 65724 A. N. S. P.

Amastra cyclostoma BALDWIN, Proc. A. N. S. Phila., 1895, p. 234, pl. 11, f. 53 (July 2, 1895).

"Animal when extended in motion .95 inches in length; posterior portion of foot tapering and very short, front portion long; head elongated, ocular and labial tentacles widely separated. Mantle dingy-white with streaks of black. Foot very light brown, superior portion and sides thickly studded with regular, dark brown granulations. Tentacles long, dark brown" (*Baldwin*).

Respecting the locality of *A. cyclostoma*, Mr. C. M. Cooke (*in litt.* Apr. 11, 1899) writes: "Mr. Judd told me that the locality of this shell is very restricted. It has been found in only one place, under a few orange trees. A circle with radius of six feet would enclose the whole space in which they have been found."

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4. A. SPHÆRICA Pease. Pl. 15, figs. 4, 5 (x 2); pl. 42, fig. 12.

The shell is narrowly umbilicate, globose-conic, moderately solid, the spire dull purplish-brown, last whorl in large part purplish-brown or chestnut, fading to rather bright yellow in the last third or fourth. Whorls 5, moderately convex, the last very obtusely subangular in front, becoming rounded in its last half or third; in old shells it descends distinctly to the aperture. The outlines of the spire are straight, or very little contracted near the apex. First whorl smooth, the next very finely, not sharply, striate; last two whorls are finely, sharply striate, the striæ quite irregular and unequal. Suture impressed. The aperture is oblique, ovate, white within. Outer lip regularly curved, obtuse, thickened within; columellar lip oblique, straight, dilated, bearing a strong, subhorizontal lamella at its lower third. Umbilicus narrow, well-like, partly covered by the expanded columellar lip.

Length 10, diam. 11.1 mm. (pl. 15, figs. 4, 5).

Length 10.6, diam. 10.2 mm. (pl. 42, fig. 12).

Kauai (Pease): Puukapele. Type in Mus. Comp. Zool.

Amastra sphærica PEASE, Journ. de Conchyl., xviii, 1870, p. 94.—*Achatinella sphærica* Pease, CROSSE, J. de C., xxiv, 1876, p. 98, pl. 1, f. 5, 5*a*.—PFR., Monogr., viii, p. 235.—BALDWIN, Catalogue, p. 10 ("Lanai"?).—*A. sphoerica* Pse., HARTMAN, Proc. A. N. S. P., 1888, p. 50.

A. sphærica is most closely related to *A. cyclostoma*, from which it differs conspicuously by the form of the last whorl, the larger columellar lamella and the smaller size. There is no tendency to agglutinate foreign matter to the shell, as in *A. obesa* and *A. agglutinans*. The surface of *A. obesa* is less sharply striate than in *A. sphærica*. Figures 4, 5 of plate 15 represent a specimen barely mature. An old shell is drawn in pl. 42, fig. 12. Both were received from Pease, and doubtless formed part of the original lot.

Series of A. umbilicata.

The shell is umbilicate or quite openly perforate, acutely ovate; the embryonic whorls are smooth and convex.

This is the most widely distributed Amastrine group except

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Amastrella, occurring on all the islands except Lanai and Hawaii. It is a primitive group, by its smooth apex, small, oblique columellar fold and open axis.

Its wide distribution may be taken as evidence for a considerable antiquity. Moreover, four or five of the seven species known are extinct, mainly occurring in deposits more or less remote from the habitats of living Amastræ. We have to do, therefore, with an ancient group, now on the verge of extinction. The species are as follows:

Kauai: *A. similaris.*

Oahu: *A. extincta, hartmani, sola, antiqua.*

Molokai: *A. umbilicata.*

Maui: *A. morticina.*

A. antiqua is a rather large, solid, thick-lipped form; *A. sola* has the verge of the umbilicus and the basal lip rounded. *A. extincta* is not certainly known to belong to this group. The other species are extremely similar, having the verge of the umbilicus and the base of the aperture subangular; and, except for their geographic separation, they might almost be considered forms of one species.

5. A. SIMILARIS Pease. Pl. 15, figs. 7, 13, 14.

The shell is *umbilicate*, ovate-conic, rather solid, with fine but rather rough and unequal striation on the last whorl. Spire straightly conic, of 5¾ rather convex whorls. The embryonic whorls are convex and smooth. The last whorl is compressed around the umbilicus, spirally guttered within it. The aperture is angular at both ends. The outer lip is obtuse, a little thickened within. Columella straight, forming an angle with the basal lip, and bearing a retreating, oblique fold near the base. Umbilicus well-like, very deep.

Length 12.5, diam. 7.7, length of aperture 6.25 mm.

Length 12.2, diam. 7, length of aperture 6 mm.

Kauai, fossil (Pease); Waimea (Pse., in coll.); Mana (Baldwin).

Amastra rugulosa Pease var. *similaris* PEASE, Journ. de Conchyl., xviii, 1870, p. 96.—*Achatinella similaris* BALDWIN, Catalogue, 1893, p. 10.

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The less swollen contour, open umbilicus and biangular aperture distinguish this species from *A. rugulosa*, from which it seems to be quite distinct. Five specimens examined, three, including the one figured (figs. 13, 14), received from Pease.

This form must be closely related to *A. extincta*, said to be from Oahu, on the authority of Frick; but as described by Pfeiffer, that shell is more slender, the aperture scarcely more than one-third the length of the shell, while the aperture of *similaris* is about half as long as the shell. Compared with *A. morticina* of Maui, *A. similaris* differs by its less attenuate early whorls.

Other specimens received from the Pease collection in Mus. Comp. Zool. are labeled Waimea, a place on the southwest coast of Kauai. They are somewhat more slender than those described above but agree with them otherwise.

Length 12.2, diam. 6.8, aperture 5.9 mm. (fig. 7).

Length 11.5, diam. 7 mm.

Subgenus AMASTRA H. & A. Adams.

Section AMASTRELLA Sykes.

Amastrella SYKES, Fauna Hawaiiensis, ii, pt. iv, Mollusca, p. 352 (May 19, 1900). Type *A. rugulosa* Pease.

The shell is rimate or imperforate, ovate-conic or oblong-conic, the embryonic whorl varying from convex to flattened and from nearly smooth to longitudinally striate; later whorls generally not variegated, covered with cuticle which is either very thin, or (in Oahuan species) dark and partly deciduous. Type *A. rugulosa* Pse.

Amastrella occurs on all of the islands, except Lanai and Maui, from Kauai to Hawaii. This wide distribution, together with the simplicity of the unspecialized shell, leads us to regard the Amastrellæ as little-changed remnants of a primitive Amastrine fauna, which, including also the Cyclamastræ, was spread over the entire group.

Series of A. rugulosa.

The shell is narrowly rimate or closed, ovate-conic, rather roughly striate, dark-colored with a white streak behind the

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outer lip and a white patch around the perforation. Confined to Kauai, but closely related to forms of Oahu and Hawaii.

6. A. RUGULOSA Pease. Pl. 15, fig. 12.

"Shell ovate-conic, thick, rimate, obliquely wrinkle-striatulate, covered with a rough brown epidermis, chestnut-colored beneath the epidermis, whitish at the lip-edge and around the base, the apex blackish. Whorls 6, convex, sometimes a little inflated. Suture impressed. Aperture ovate, vertical. Columellar fold strong, callous, compressed, almost transverse. Lip thickened. Length 12, diam. 9 mm." (*Pse.*).

Kauai (Pease): Kapaa (Baldwin); Lihue (Perkins). Type in Mus. Comp. Zool.

Amastra rugulosa PEASE, Journ. de Conchyl., xviii, 1870, p. 95.—BALDWIN, Catalogue, p. 10.—SYKES, Fauna Hawaiiensis, p. 354.—*Achatinella* (*Amastra*) *rugulosa* Pse., CROSSE, J. de C., xxiv, 1876, p. 99, pl. 1, f. 4, 4*a*.—HARTMAN, Proc. A. N. S. Phila., 1888, p. 49 ("Kula, East Maui").

This species is decidedly more roughly sculptured than *A. nucleola*, more obese, the whorls are more convex, and the columellar lamella is stronger. It is very much like *A. sphærica* in texture and color, but that is a shorter shell with a larger umbilicus and no basal white area. The outlines of the spire, while nearly straight, are perceptibly though weakly convex below and concave above. The sculpture, at the early stage, is like that described for *nucleola*. Whorls 5½ to 5¾, the first brown or purplish-brown (not blackish, as Pease states). The last whorl has rough, uneven striæ, but no spiral lines. It has a white area at the base, and a narrow streak behind the lip is white or whitish. The aperture is brown inside, but there is a narrow white rim within the obtuse lip. Columellar fold quite strong. There is an axial perforation, half closed by the columellar lip. Two specimens of the original lot, received from Mr. Pease, have been examined, one being figured (fig. 12).

Length 12, diam. 8.2 mm.; aperture length 6 mm.

Length 11.5, diam. 8.1 mm.; aperture length 6 mm.

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Dr. Hartman's locality "Kula, East Maui" is doubtless an error.

6*a*. *A. rugulosa normalis*, n. subsp., pl. 42, fig. 9; pl. 15, figs. 8-10.

A large series from Kipu, in coll. C. Montague Cooke and A. N. S. P., consists of shells which are *thinner* than typical *rugulosa*, with *less roughened* surface and a half whorl more. The color is typical in most examples; in some there is a pale band below the periphery, or the entire last whorl may be of a rich reddish-chestnut color, the spire paler.

Length 12, diam. 8 mm.; 6 whorls (pl. 42, fig. 9; type).

Length 11.2, diam. 8.1 mm..

In an embryo of barely two whorls the periphery is sharply angular. The columella is spiral but has no callous fold superposed. The axis is very minutely perforated. Externally it is finely, very weakly striate, nearly smooth.

Other specimens, without other locality than Kauai, are illustrated in figs. 8, 9, 10, of plate 15. These shells are thicker than those of Kipu, but have the same smoothish surface. The axis is very slender and distinctly sinuous in the second whorl; then rather large in the last three whorls, still sinuous; in the last 1½ whorls it bears a strong superposed lamella (pl. 15, fig. 8). The apical sculpture, as drawn in fig. 9 from a worn example, gives an imperfect, somewhat erroneous idea. Cotypes are no. 104685 A. N. S. P. and 2316 Cooke collection.

7. A. NUCLEOLA (Gould). Pl. 15, figs. 16, 17.

"Shell solid, imperforate, ovate-globose, livid chestnut, the apex pale, at the suture and anteriorly whitish. Whorls 6, somewhat tabulate posteriorly. Aperture rounded; lip simple; columella excavated, covered with a callus; fold small. Length nine-twentieths, width one-fourth inch. [11¼x6¼ mm.].

"A small solid species, of a livid hue, whitish at the tip and the neighborhood of the suture, and milk-white just before the termination of the whorl at the aperture" (*Gld.*).

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Kauai (Newcomb): Hanalei (Baldwin); Waiole (Gulick). Type no. 1172 N. Y. State Museum at Albany.

Achatinella nucleola GLD., Proc. Boston Soc. N. H., ii, p. 28 (Jan., 1845).—PFR., Monogr., ii, p. 241; iii, 457; iv, 545; vi, 178.—*Amastra nucleola* Gld., BALDWIN, Catalogue, 1893, p. 9.—SYKES, Fauna Hawaiiensis, p. 353, no. 93.—GULICK, Evolution, Racial and Habitudinal, p. 38, pl. 1, f. 2 (Waiole).—*Achatinella brevis* PFR., Proc. Zool. Soc. Lond., 1845, p. 90 (1846). Monogr. Hel. Viv., iii, 458; vi, 181.

A shell 3.5 mm. long of 2½ whorls shows the first 1½ whorls smooth, extremely fine, faint striæ then appearing. There is a well-developed axial lamella. In adults the spire is more or less tinted with brown, the last whorl deepening to dull purple; a band below the suture, a patch around the small axial perforation and a wide stripe behind the lip being pure white. The last whorl is irregularly, rather finely, wrinkle-striate. The lip is obtuse and thickened a little within. The contour varies somewhat.

Length 11.9, diam. 6.9, length of aperture 5 mm.

Length 10.7, diam. 6.9, length of aperture 4.9 mm.

Length 11, diam. 6.1, length of aperture 4.8 mm.

A. rugulosa is its nearest ally, but that is larger, more obese, with a coarser surface and no subsutural white band.

Though common in collections, all the specimens seen have the appearance of having been collected dead. The specimens figured are from Waiola, Gulick coll. W. H. Pease states that he collected the veritable *A. nucleola* only at Manoa, Oahu (Journal de Conchyliologie, 1870, p. 96), but this locality has not been confirmed, and is apparently an error.

Harper Pease, followed by Mr. Sykes, places *A. brevis* Pfr. as a synonym of *A. nucleola*. The description, given below, is discrepant in the phrase "*T. non rimata*" and in color. Only one shell in a large series of *A. nucleola* examined has the axial crevice closed. It is almost invariably open, though narrow and short.

Achatinella brevis Pfr.—Shell not rimate, ovate-conic, solid, obliquely striatulate, glossy, reddish-brown. Spire convexly-

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conic, rather acute. Suture simple, white. Whorls 6, convex, the last equaling two-fifths the total length. Columella subarcuate, provided at the base with a minute, tooth-like tubercle. Aperture little oblique, half-oval. Peristome unexpanded, thick, obtuse, white. Length 11, diam. 6½ mm.; aperture with peristome 5 mm. long. Sandwich Is., Cuming coll. (*Pfr.*).

8. A. ANTHONII (Newcomb). Pl. 15, figs. 15, 18, 19.

"Shell conically ovate, solid, blackish-brown, longitudinally striate. Whorls 6, inflated, suture moderately impressed. Apex obtuse. Aperture obliquely ovate, subangulate below. Lip simple, thickened within. Columella short, straight, with a somewhat callous plication below the middle. White-banded below the suture, and of a dirty white in the umbilical region. Length 15, width 10, length of aperture 6, width 4½ mm." (*Newc.*).

Kauai (at Kaloa?) (Johnson). Type in Mus. Cornell Univ.

Achatinella anthonii NEWC., Proc. California Acad. of Nat. Sci., ii, p. 93, 1861; Amer. Journ. of Conch., ii, 1866, p. 210, pl. 13, f. 2.—*Amastra anthonyi* Nc., PEASE, P. Z. S., 1869, p. 649.—*Achatinella anthonyi* Newc., HARTMAN, Proc. A. N. S. Phila., 1888, p. 44.

The outlines of the spire are a little convex, and the apex is more obtuse than in *A. rugulosa*. The striation is rough and irregular, and *on the last 2½ whorls there are spiral striæ*, weakly shown in fig. 19. The spire is purplish-brown, the last whorl of the same shade or lighter reddish-brown. The pale sutural band and axial patch mentioned by Newcomb seem to be always present, though varying in intensity and width. The first two whorls are smooth. The shape varies from oblong-conic to ovate-conic.

Length 18.5, diam. 10, aperture 8 mm.; 6 whorls.

Length 16, diam. 9.5, aperture 7.7 mm.

Length 16, diam. 10.3, aperture 8 mm.

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AMASTRÆ OF OAHU.

Oahu has representatives of four subgenera or sections of Amastra. *Amastrella* and *Cyclamastra* are widely-spread groups in other islands, while *Metamastra* and *Paramastra* are special to this one. A single species, *A. elongata* Newc., has been referred to *Heteramastra*, but its claim to a place in the Oahuan list is questionable.

The island consists of two volcanic masses, a higher, probably older western mass, the Waianae or Kaala range, and a larger, lower, eastern or Koolau range, which has been shown by Dana to be later, or at least to have continued in active eruption later than the other, by the encroachment of its lava streams over the base of the Waianae range. The saddle between these ranges reaches an elevation of nearly 900 feet. It is arid or grassy, and supports no *Achatinellidæ*.

Pterodiscus, Cyclamastra and *Laminella* are common to both ranges. *Metamastra* and *Amastrella* are characteristic of the Koolau range, the former with 15, the latter 9 species. Three forms of Metamastra, *all varieties of Koolau species*, occur in the Waianae range, and there are two Waianaean *Amastrellæ*, one varietally connected with a Koolau species, the other specifically distinct.

Armsia and *Planamastra*, each with one species, are known from the Waianae range only. *Paramastra*, with 7 species, is also characteristic of the Waianae range. Two of these species occur also in the Koolau range, where there are also two distinct species of the same group. The *cornea* group is likewise probably of Waianaean origin, two species being from that range, and two, rare and local, in the Koolau range. Not much weight is to be attached to this series, since the relationship of the Waianae and Main Range species is rather uncertain. See pp. 138-9, where the species of both ranges are enumerated.

It appears from the data in hand that both eastern and western areas existed as independent evolution-centers for a period sufficiently long for the evolution of distinct subgeneric groups of Amastræ in each, while *Planamastra* and *Armsia* became differentiated in the Waianae, and various

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groups of Achatinellæ in the Main or Koolau range. Following this long period of isolation, in quite modern times, within the lifetime of existing species, the two radiation-centers were transiently connected by a forest area across the intervening saddle, which had meantime been built up from a lower level or from below sea-level. This allowed the migration of a few virile species from range to range.

Aside from this geologically very recent exchange of species between the two Oahuan radiation-centers, there is no evidence whatever to show that the fauna of either range was derived from the other. The truth probably is that both arose from an early tertiary fauna which occupied a more extensive land, upon which the existing volcanic deposits were superposed during Neocene time, with synchronous subsidence of the ancient ridge. I cannot find one shred of evidence for Hyatt's contention that the southeastern end of the Main Range was the primary radiation-center and that the Waianae fauna was derived from the eastern range.

The deposits containing fossil land shells are probably Pleistocene, possibly Pliocene. That on Diamond Head is believed by Branner to have been an old forest deposit covered with talus. Its fossils belong to modern groups of the same district, though not now living in the same locality.

The first Achatinella known, *Helix apex-fulva* Dixon, was obtained in Oahu (June, 1786) from a necklace probably made in Kawailoa valley. In 1819 the French corvette *Uranie* visited Hawaii, Maui and Oahu, lying in Honolulu harbor. In the neighboring valleys, probably Nuuanu and Manoa or Palolo, the following species were obtained: *Achatinella vulpina, gravida* var. *gracilis, decora, lorata; Amastra turritella, textilis, tristis*; and *Lept. ventulus. Amastra luteola* also may have been from Oahu, but it is more likely a Hawaiian shell related to *A. flavescens. Amastra spirizona* they also obtained, no doubt from the natives, as it occurs only in western Oahu. The next collection of importance was made by Lord Byron in H. M. S. *Blonde*, 1824, who brought home a shell necklace, composed of *Achatinellidæ* special to Kawailoa valley, near the western end of the main range, and

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described by Swainson. Subsequent to these pioneer collections the work was taken up by Newcomb, Frick (whose shells were described by Pfeiffer), Gulick, and after the lapse of many years by Baldwin, bringing us to the workers of to-day, who have begun a new period of active investigation of this wonderful fauna.

Key to Oahuan Amastræ.

a. Shell umbilicate; embryonic whorls smooth. *Cyclamastra,* p. 158.

*a*¹. Shell imperforate or narrowly rimate.

b. Sinistral.

c. Ovate-conic, rather stout. *A. thaanumi,* no. 22.

*c*¹. Oblong-turreted, slender. *A. elongata,* no. 54.

*b*¹. Dextral.

c. Shell turreted or pyramidal, often banded. *Paramastra,* p. 208.

*c*¹. Shell ovate, oblong or globose-conic.

d. Curve below the columellar lamella well rounded. *Amastrella,* p. 191.

*d*¹. Curve below lamella narrow, spout-like. *Metamastra.*

e. Stout, often variegated, *variegata* group, p. 163.

*e*¹. Slender, spire concavely conic, *cornea* group, p. 187.

The following Amastræ are enumerated without descriptions in Baldwin, Catalogue Land and Fresh-Water Shells of the Hawaiian Islands, 1893.

Achatinella ferruginea Bald. Ewa and Waianae Mts., Oahu (p. 9).

Achatinella testudinea Bald. Ewa, Oahu (p. 10).

Subgenus CYCLAMASTRA Pilsbry & Vanatta (p. 147).

Series of A. umbilicata; p. 149.)

9. A. SOLA n. sp. Pl. 38, figs. 6, 9, 10.

The shell is openly perforate, conic, thin, with but little

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luster, the last whorl or two dark reddish-brown with some light lines and patches, those above pale yellowish from incipient decay of the cuticle. Outlines of the spire are straight, but the individual whorls are very strongly convex. Embryonic whorls smooth; later whorls with irregular sculpture of fine growth-wrinkles. Aperture reddish-brown within, the lip very thin, acute; basal margin well rounded. Columellar margin straight, dilated above, arching over the narrow umbilicus. Columellar fold thin, very small and strongly oblique. Length 9.8, diam. 6, aperture 4.9 mm.; 5⅓ whorls.

Oahu: Wahiawa (Thaanum, type loc.); Kawaihulona (Spalding). Type to be placed in the Bishop Museum.

A. hartmani is a more obese shell with larger umbilicus. *A. umbilicata* has the whorls but slightly convex, "*anfr. 6 vix convexiusculi*" (Pfr.). *A. extincta*, a larger shell, has similarly low convexity "*anfr. 7 vix convexiusculis*" (Pfr.). In *A. sola* the convexity of the whorls is unusually emphatic. Compared with a Molokai specimen of *A. umbilicata*, this Oahuan shell differs by the more convex whorls, the last whorl wider, not angular around the umbilicus, and the aperture is rounded below, not angular as in *umbilicata*.

10. A. EXTINCTA (Pfeiffer).

"Shell perforate, ovate-turrite, solid, striatulate, chalky. Spire long, tapering upwards, acute. Whorls 7, scarcely convex, the last less than one-third the total length, somewhat compressed around the perforation. Aperture slightly oblique, rhombic-oval, angular at the base. Columellar fold compressed, ascending almost from the base. Peristome simple, unexpanded, the margins joined by a thick, somewhat nodiferous callus, columellar margin dilated, free. Length 16, diam. 7.5 mm.; aperture 5.5 mm. long, 3 wide" (*Pfr.*).

Oahu, subfossil (Frick, in Cuming coll.).

Achatinella extincta PFR., P. Z. S., 1855, p. 204; Monogr., iv, 550.—THWING, Occ. Papers B. P. B. Mus., iii, p. 184; *Amastra extincta* Pfr., SYKES, Fauna Hawaiiensis, p. 336.—*L[eptachatina] hartmani* Newc., HARTMAN, Proc. A. N. S. Phila., 1888, p. 54, in part; not pl. 1, fig. 12, "type".

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Pease (P. Z. S., 1869, p. 651) and Hartman, 1888, referred *extincta* to *Leptachatina*. Dr. Newcomb (in Hartman, 1888) renamed the shell on the ground that having been found recent, *extincta* was a misnomer. Mr. Sykes thinks that the recent shells in question were probably erroneously identified as Pfeiffer's species, an opinion which I share. *A. extincta* has not been figured. The scarcely convex whorls should be a diagnostic character. Being described as "perforate," it probably belongs to the *inflata* series of Amastræ; but on account of its connection in the literature with *A. hartmani*, we leave it in this group temporarily.

11. A. HARTMANI 'Newcomb' Hartman. Pl. 38, fig. 11.

Hartman figured as the type of *L. hartmani* a fossil shell received from Newcomb as from Oahu, which differs from Pfeiffer's description of *A. extincta* by its very much broader shape and distinct umbilicus. The photograph from which Hartman's figure was drawn measures, length 12.1, diam. 8.8 mm. It is reproduced on our plate 38. No description of this shell has been published, since Hartman considered it specifically identical with *A. extincta* Pfr. It is therefore defined solely by the figure.

Oahu, fossil. Type in Hartman coll., Hamburg Mus.

L[eptachatina] hartmani Newc. (MS. coll. Newcomb), HARTMAN, Proc. A. N. S. Phila., 1888, p. 54.—*Leptachatina hartmanii* Newc., HARTMAN, t. c., p. 56, pl. 1, f. 12 (April 24, 1888).

Hartman based his species *hartmani* on Pfeiffer's description of *A. extincta* and on a specimen which he expressly designates as the type. It is proposed to restrict the name to the latter.

Photographs of two recent Oahu specimens referred by Hartman to *L. hartmani* are in the collection of the Academy. They are much less inflated than the type, and probably not identical with it.

12. A. ANTIQUA Baldwin. Pl. 32, figs. 22, 23.

"Shell fossil, dextral, narrowly but deeply perforated, the

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perforation penetrating almost to the apex; solid, elongately ovate, apex subacute; surface sculptured with rude, irregular lines of growth, the apical whorls smooth. Color of the living shell unknown. Whorls 6, convex; suture well impressed. Aperture a trifle oblique, sublunate; peristome thickened within, columellar margin adnate, slightly expanded over the umbilicus, extremities somewhat converging and united by a thick parietal callosity; columella flexuous, terminating in a narrow plait. Length 20, diam. 12 mm." (*Baldw.*).

Oahu: Ewa.

Amastra antiqua BALDWIN, Proc. A. N. S. Phila., 1895, p. 233, pl. 11, f. 47.

"We received this species from Prof. A. B. Lyons, of Oahu College. He reports that he found at Ewa a singular accumulation of these and other fossil land shells, huddled together in one spot in a bed of soft tufa-like material, at an altitude not far above sea-level. The existence of living examples of this and the following species now, or within any recent period, is highly improbable" (*Baldwin*).

The sculpture consists of coarse, unequal wrinkles separated by finely, irregularly striate intervals, the embryonic shell appearing smooth in the fossil examples. It is narrowly *umbilicate*, rather than "perforated," as described by Mr. Baldwin, the umbilicus being nearly 1 mm. wide. The spire is slightly contracted near the summit. The peristome is obtuse with a callous rib within. There is a low, oblique nodule or callous ridge on the parietal wall some distance within, above and rather near the origin of the columella. The parietal callus is rather thick at the edge in adult shells. Two specimens of the type lot measure:

Length 20.3, diam. 13, aperture 10 mm., whorls 6.

Length 18, diam. 11.5, aperture 8.2 mm., whorls 6¼.

This species is probably related to the group of smaller forms comprising *A. similaris* Pse. (Kauai), *A. hartmani* Nc. (Oahu) and *A. morticina* Pils. (Maui). In all of these forms the umbilicus is large for an *Amastra*, the embryonic whorls are smooth, the columellar lip free and not much dilated, and the columellar lamella rather small and oblique. *A. antiqua*

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differs from the others by its rough sculpture and large size. The thickening-up of the parietal callus is probably an old-age feature, which is often correlated with increasing aridity of station. Figured from a co-type in coll. A. N. S. P.

Section METAMASTRA Hyatt & Pilsbry.

Imperforate or narrowly rimate Amastræ with very finely striate or smoothish embryonic whorls, strong, subhorizontal columellar lamella, the sinus below it narrow and deep, somewhat spout-like. Type *A. variegata* Nc.

Series of A. variegata.

Amastræ of compact shape, the spire usually *convexly* conic, whorls 5½ to 6½; apex rather obtuse, the embryonic whorls convex, very finely striate or nearly smooth (except in *A. badia*); later whorls with *no dull outer coat of cuticle*, usually variegated with opaque buff interrupted bands or streaks; rather glossy. Outer lip generally thickened within; columellar lamella strong, subhorizontal, the *sinus below it rather spout-like.*

These forms differ from the group of *A. rubens* and *inflata* chiefly by the spout-like basal sinus of the aperture, produced by an angulation of the whorl around the axis, noticeable behind the columella in adult shells, while in the neanic stage the basal part of the shell is rather straightly conic. The cuticle, moreover, never has a conspicuous, dull, deciduous layer, as is usual in the *inflata* group.

This Oahuan group has been differentiated from *Amastrella* by the development of variegated coloration in the "middle layer" (not the outer, more or less deciduous cuticle, as in variegated species of Molokai and Maui), and by the peculiar shape of the sinus below the columellar lamella. It comprises two series of species: *Series of A. variegata* (see below), and *Series of A. cornea*, acutely ovate shells with the spire attenuate, species 41 to 44.

Metamastra is here used in a somewhat wider sense than originally limited by the senior author.

The *reticulata* series is copiously developed in the eastern

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part of the Main Range of Oahu, where there are many species and races, some of them very local, others more widely ranging. Two species, *albolabris* and *reticulata* have migrated to the Waianae Range also.

Key to Species of the Variegata Series.

1. Shell sinistral, oblong, chestnut with darker spire. *A. thaanumi*, no. 22.
   Shell dextral, 2.
2. Outlines of the spire concave; chestnut-brown; 11x7 mm. *A. irwiniana*, no. 17.
   Outlines of spire straight or convex, 3.
3. Shell and parietal callus very thick; oblong-conic; length 14 to 15, diam. 8 mm. *A. solida*, no. 23; *A. venusta*, no. 24.
   Parietal callus thin or moderate, 4.
4. A thread and groove above suture on 3d and 4th whorls; cylindric-oblong. *A. spaldingi*, no. 15.
   Smooth above suture, 5.
5. Shell distinctly or strongly striate, and usually decussated with spirals, 6.
   Shell weakly striate or smoothish, 8.
6. Reddish-brown and whitish, sometimes banded, under a yellow cuticle; 16x9 to 14x8¼ mm. *A. albolabris*, no. 18; *A. subrostrata*, no. 19.
   Deep brown, rather rudely striate and minutely decussate; 17x9⅓ mm. *A. sericea*, no. 20.
   Dark brown, oblong-conic, widest near the base; finely, rather weakly striate; 16.5x9.2 mm. *A. davisiana*, no. 21.
   Fossil, Diamond Head; *cylindric*-conic; 14x7.1 mm. *A. caputadamantis*, no. 28.
   Maculate, banded, or with ragged streaks of whitish on a dark brown ground; striation and incised spirals generally strong, 7.
7. Small, 12 to 13 mm. long. *A. transversalis*, no. 27.
   Larger, 19x12 mm.; globose-ovate; embryonic whorls striate. *A. undata*, no. 29.

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Large, about 20 mm. long, ovate-conic, embryonic whorls unevenly ribbed. *A. badia*, no. 30.

8. Shell globose-conic, diam. about two-thirds or three-fourths the length, 9.
   Shell oblong-conic or ovate, not so wide, 12.
9. Dark brown under a greenish-yellow suffusion, 10.
   Brown or pale, usually banded or speckled with white, 11.
10. Much depressed, periphery angular in front; 10x7.7 mm. *A. gulickiana*, no. 14.
    Ovate, periphery rounded; length 14, diam. 8 to 9 mm. *A. t. media*, no. 13*a*.
11. Thin; whitish, pale or dark brown, usually sparsely banded with white. *A. pellucida*, no. 16.
    Rather solid, speckled or banded with whitish. *A. reticulata*, no. 25.
12. Aperture small, contained about 2½ times in the length; mottled and streaked with yellow on a dark ground; 16.7x8 mm. *A. cookei*, no. 26.
    Aperture about half the length of shell or more. *A. textilis*, no. 13; *A. reticulata* var., no. 25.

13. A. TEXTILIS (Férussac). Pl. 30, figs. 1 to 7.

"Shell dextral, ovate, the summit acuminate, engraved with longitudinal and transverse striæ; epidermis buff or reddish, fugacious; whorls 5; aperture semilunate; peristome thickened within; columella short, provided with a distinct rib; umbilical crevice hardly distinct. Length 6⅔, diam. 3¾ lignes. Sandwich Is." (*Férussac*).

Oahu, southern slope of the eastern third of the Main range: Waialae, Palolo, Manoa, Nuuanu, Moanalua, Halawa (Gulick, Cooke).

Helix textilis FÉRUSSAC, Voy. Autour du Monde de l'Uranie et la Physicienne, par L. de Freycinet, Zoologie, p. 482 (1824). —*Achatinella textilis* NEWCOMB, Annals of the Lyceum of N. H. of N. Y., vi, 1858, p. 305.—BALDWIN, Catalogue 1893, p. 10.—BINNEY, Ann. Lyc. N. H. of N. Y., xi, p. 190, pl. 14, f. G (radula).—*Amastra textilis* HARTMAN, Proc. A. N. S. Phila., 1888, p. 50, pl. 1, f. 8.—SYKES, Fauna Hawaiiensis, p. 345, no.

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60.—*Achatinella microstoma* Gld., Proc. Bost. Soc. N. H., ii, 1845, p. 28.—*Achatinella ventulus* Fér., Pfeiffer, P. Z. S., 1845, p. 89; Monogr., ii, p. 241; Conchyl. Cab., p. 287, pl. 67, f. 12, 13. — Reeve, Conch. Icon., vi, 1850, pl. 4, f. 31. — Thwing, Orig. Descriptions, p. 143, pl. 3, f. 14. Not of Férussac.—*Achatinella ellipsoidea* Gould, Proc. Bost. Soc. N. H., ii, 1847, p. 200; U. S. Expl. Exped. Moll., p. 87, pl. 7, fig. 96.—*Leptachatina textilis* Fér., W. G. Binney, Ann. N. Y. Acad. Sci., iii, p. 99, pl. 6, f. G (teeth).

Férussac's diagnosis of this species is not good. If the truth be told, he had little talent for description, and his taxonomic instinct was generally at fault. Bruguière's descriptions and Lamarck's systematics are on a higher plane. It was Dr. Newcomb who first recognized the real identity of *Helix ventulus* and *H. textilis*, having seen the type specimens of both in the Jardin des Plantes. The typical form seems to have been one of the rather unusual specimens marked with spiral lines, such as are found in Nuuanu valley.

A. textilis is imperforate or sometimes slightly rimate, solid, oblong-conic, polished, with weak sculpture of fine, uneven growth-wrinkles. Color rich chestnut (varying in intensity), paler, and usually *yellow below the suture and around the columella;* spire purplish-brown. The chestnut color sometimes gives place to yellowish, or again there may be an olive or greenish tinge (the color of the form Gould called *A. microstoma*). Some yellow shells have numerous indistinct olive-brown spiral lines, and these may be very slightly sunken (fig. 6, Waialae); an example so marked was described by Férussac. Old shells generally show scattered golden flecks, or whitish lines and dots, from disintegration of the cuticle. The spire has convex outlines below, straight near the apex. Whorls 5½ to 6½, but little convex. The second embryonic whorl has very fine, close longitudinal striæ, which in some shells are cut by smoothish spiral bands. The last whorl is more or less convex. Aperture small, rather oblique, flesh-tinted inside, the outer lip strengthened by a narrow whitish rib within the acute edge. The columellar lamella is strong and subhorizontal; there is a sort of gutter at the junction of

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the columellar and basal margins, quite unlike the rounded curve of *A. decorticata*, etc., but similar to the *reticulata* group. Parietal callus usually rather thick, but thin at the edge and transparent.

Fig. 3. Length 15.5, diam. 7.8, aperture 7 mm. Palolo.
Fig. 1. Length 15, diam. 8.5, aperture 6.9 mm. Palolo.
Length 14.5, diam. 8.7, aperture 6.9 mm. Palolo.
Fig. 2. Length 14, diam. 9, aperture 7.2 mm. Palolo.
Length 13.2, diam. 8.1, aperture 7 mm. Palolo.

From the figures and measurements it will be seen that the shape varies within very wide limits, from the more oblong form of typical *textilis* to a globose-conic shape exactly like *A. breviata*. Many of these short shells are really indistinguishable from the latter, though they may generally be separated by the greater solidity and smoother, glossy surface of *A. textilis*.

The specimens from localities mentioned above do not differ materially, all the lots being variable. Several shells from a large series from Nuuanu (pl. 30, figs. 4, 5) measure:

Length 18, diam. 9.5, aperture 8.3 mm.
Length 17.5, diam. 9.5, aperture 8 mm.
Length 16, diam. 9, aperture 7 mm.; whorls 6½.
Length 15.2, diam. 8, aperture 7 mm.; whorls 6½.
Length 13.8, diam. 8.5, aperture 6.8 mm.; whorls 6.
Length 13, diam. 8.5, aperture 6.8 mm.; whorls 5¾.
Length 12.5, diam. 8.8, aperture 6.5 mm.; whorls 5½.

In his "Reprint of the original descriptions of the genus Achatinella," p. 143, under *ventulus*, Mr. Thwing gives part of Reeve's description of his *ventulus* (= *textilis*), at the same time quoting Newcomb's notes relating to *Leptachatina ventulus* (see p. 54), thus confusing two distinct species belonging to different genera. On p. 146 the original description of *textilis* is given.

Gould described this species twice; in 1845 under the name *A. microstoma*, no exact habitat, and in 1848 as *A. ellipsoidea*, from Maui. The type of *A. microstoma* has been lost, but it has generally, and doubtless correctly, been considered a synonym of *textilis*. The original description follows.

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A. microstoma (Gld.). "Shell ovate, imperforate, solid, epidermis greenish-brown. Whorls 6, the last ventricose. Aperture small, ovate-rounded, the throat livid; lip simple, thickened within; columella deeply sinuous, covered with a thick callus, fold strong. Distinguished by its ovate form, dusky green exterior, and small, strongly fortified aperture. Length three-fifths, diam. seven-twentieths of an inch" [15x 8.75 mm.] (*Gld.*).

Compact greenish forms of *textilis*, which are evidently "microstoma," occur from Moanaloa to Nuuanu and on Tantalus. A series from Nuuanu (Cooke coll.) is figured, pl. 30, figs. 8, 9, 10. The spire is darker than the last whorl, mainly purplish-brown; the last whorl is yellowish-green or brown-clouded green, or there may be brownish bands on a yellow-green ground, or yellow bands on a brown ground.

The integradation between these shells and normal *textilis* is complete, and we attach little importance to the distinction.

A. ellipsoidea, of which we have examined Gould's figured type, is no. 5498 U. S. Nat. Mus. (pl. 40, figs. 17, 18). It certainly never came from Maui, as supposed by Gould, being merely a variegated *textilis*, exactly like some of the Nuuanu specimens. The ground-color is brown, a white band appearing below the suture on the penult. whorl, widening on the last whorl, where it spreads downward. There are some narrow whitish spiral lines in the peripheral region, and a rather large yellow basal patch. It may be noted that Gould himself compares it with "*ventulus*" Fér., a name at that time used for *textilis* Fér. It has been united erroneously with *A. pupoidea* Newc., which belongs to a separate series. The type is figured.

13*a*. *A. textilis media* Hyatt & Pilsbry, n. subsp. Pl. 30, figs. 11, 12.

The shell is short, rather thin, perforate, compactly ovate-conic, the outlines of the spire slightly convex; sculptured with fine growth-wrinkles; dull purplish-brown under a very thin cuticle which with age becomes light greenish-yellow in lines and streaks, or throughout on the spire, "dead" shells

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becoming greenish-yellow throughout; aperture purplish within, the lip, columellar lamella and parietal callus thin.

Length 14, diam. 8.6 mm.; 5¾ whorls (figs. 11, 12).

Length 12, diam. 7.5 mm.; 5½ whorls.

Aeia (a short valley splitting the ridge northwest of Halawa), co-types no. 1050 Cooke coll., 104686 A. N. S. P., and 13378 Bost. Soc. coll.

Perhaps a form dwarfed by unfavorable conditions, but recognized by the senior author in MSS. as a distinct species. Some examples without definite locality in coll. A. N. S. P. are rather solid with thickened lip. Its range lies on the extreme northwestern border of the known range of *A. textilis*.

13*b*. *A. textilis kaipaupauensis* n. subsp. Pl. 38, fig. 12.

The shell is short, subperforate, thin, with *straightly conic* spire and convex whorls, the last quite rotund; dull purplish-brown, the thin cuticle yellowish on the early whorls. Embryo finely striate; later whorls with fine, irregular sculpture of growth-wrinkles. Aperture purplish within, the lip very narrowly thickened. Columellar lamella thin, its lower edge subhorizontal. Length 11, diam. 7.1, aperture 6 mm.; 5⅓ whorls.

Kaipaupau (Spalding coll.).

Near the above, yet with narrower, straightly conic spire and more convex whorls. Type to be deposited in the Bishop Museum.

14. A. GULICKIANA n. sp. Pl. 38, fig. 8.

Shell narrowly perforate, globose-conic, rather solid, glossy, without dull or deciduous outer cuticle. Spire very short, its outlines very slightly convex, nearly straight, the summit obtuse. Embryonic whorls nearly smooth, the first dull purple, the rest covered with a thin, light greenish-yellow cuticle, becoming reddish-brown on the latter part of the last whorl. Embryonic whorls apparently smooth, rather convex; following whorls lightly marked with growth-striæ, less convex, the last whorl subglobose, subangular in front of the aperture, becoming rotund in the last two-thirds. Aperture somewhat

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oblique; interior purple, becoming paler and a little thickened near the lip. Columella short, bearing a moderate and not very oblique fold below the middle, the edge dilated above the fold. Parietal callus thin, purple. Length 10, diam. 7.7, aperture 5.3 mm.; 5⅓ whorls.

Oahu: Opaiula (Irwin Spalding). Type to be deposited in the Bishop Museum.

This peculiar shell is probably a derivative from the *A. textilis* stock, but its locality is far to the northwest of the *textilis* area. The coloration—a greenish-yellow suffusion over dark red-brown—is the same as in some forms of *textilis* from Nuuanu and elsewhere. The summit is more obtuse than in *textilis*, and the last whorl retains a juvenile feature in the angulation of the periphery in front. It is a very rare species, known up to this time by two specimens, taken by Mr. Spalding. The shorter shape and very obtuse summit differentiate *A. gulickiana* from the small varieties of *A. textilis*. It is a very distinct species.

15. A. SPALDINGI Cooke. Plate 30, fig. 14; pl. 38, fig. 13.

"The shell is imperforate, dextral, cylindrically ovate, somewhat thin, irregularly and faintly striate with lines of growth, the third whorl distinctly and diagonally striate, the third and fourth whorls having *a distinct spiral thread just above the sutures*, the first three whorls light brown with a yellowish tinge, the lower three of a uniform dark resinous chestnut. Spire subcylindrical, with slightly convex outlines, apex somewhat obtuse. Suture simple, hardly impressed. Whorls 6½, increasing somewhat regularly, the embryonic somewhat convex, the rest flatly convex, the last cylindrical, tapering gradually towards the base. Aperture subpyriform, bluish within, scarcely oblique. Columella nearly straight, hardly twisted; columellar fold basal, rather small, thin, oblique, flexuous. Outer margin of lip regularly curved, erect, thin, forming a slight angle with the base of the columella; columellar margin thin, appressed, adnate. Length 18.9, diam. 9.6, length of ap. (diagonal) 8.1 mm." (*Cooke*).

Oahu: Summit of Konahuanui, at 3,300 ft. (Spalding). Type no. 16451, Bishop Museum.

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Amastra spaldingi COOKE, Occas. Pap. B. P. Bishop Museum, iii, p. 18[214], f. 2 (July 24, 1908).

Figured from specimens 17738 and 17612, Bishop Mus. Its nearest congener is probably *A. textilis* Fér., from which it differs by the larger size, more cylindric form, and especially by the spiral threads above the suture, on the third and fourth whorls, a feature peculiar to this species. These spirals are best shown in the enlarged view of the neanic stage, pl. 38, fig. 13. Named in honor of Mr. Irwin Spalding, of Honolulu.

16. A. PELLUCIDA Baldwin. Pl. 30, fig. 13.

"Shell dextral, imperforate, very fragile, thin, translucent, globosely conic, apex rather acute; surface lusterless, sculptured with fine incremental lines, apical whorls smooth. Color light-brown, apex darker; destitute of epidermis. Whorls 5½, somewhat convex; suture moderately impressed. Aperture oval, a trifle oblique, livid-white within; peristome simple, thin; columella white, flexuous, abruptly terminating in a thin lamellar plait. Length 12½, diam. 8 mm.

"Animal of a uniform brown color; the head above and tentacles of a darker shade. The action of the heart is plainly visible through the thin texture of the shell. When first collected the pulsations were about fifty per minute, growing slower and fainter from day to day until the animal died" (*Baldwin*).

Oahu: Waianae Valley. Co-types no. 65721 A. N. S. P.

Amastra pellucida BALDWIN, Proc. A. N. S. Phila., 1895, p. 231, pl. 11, f. 45, 46 (not f. 41, 42).

"This species is well characterized by its thin pellucid texture, globose form, abbreviated spire, and light brown color" (*Baldwin*).

The type specimen which served for Mr. Baldwin's measurements and fig. 45 of his plate is drawn in fig. 13. It is an adult shell, white under a thin, very pale straw-colored cuticle, which is deciduous in a band below the suture, the first 3 whorls being rather light brown and smooth. Though thin, it is not fragile, but moderately strong. The aperture is white

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within and the lip is strengthened by a narrow but distinct white rib within the edge. The columellar lamella is strong and subhorizontal, and there is an extremely narrow umbilical slit in all of the specimens (4) of the type lot. Consequent upon the angularity of the base, around the axis, the junction of columellar and basal lips is somewhat spout-like.

The other three shells are immature, wanting the lip-rib. One is colored like the type, but the other two are of a slightly transparent and dilute reddish-brown tint, the apical whorls much darker in one example. All three show traces of a few whitish or creamy spiral lines, at and above the periphery, and all are covered with a thin cuticle. The periphery is noticeably angular in front of the aperture in these immature shells, but hardly perceptibly so in the adult type specimen. The shortest shell measures, length 11.5, diam. 8.3 mm.

The following form from the Main Range of Oahu approaches *pellucida* so closely that I hardly see the way clear to separate the two forms as species, though I must admit the possibility of convergent evolution in this case.

16*a*. A. BREVIATA Baldwin. Pl. 30, figs. 15, 17, 18.

Shell a little more solid, reddish-chestnut, pale below the suture, behind the lip and around the perforation, and often encircled with interrupted creamy lines and bands, at and above the periphery. Aperture flesh-colored within; lip very little thickened; otherwise as in *A. pellucida*. Length 12.3, diam. 8 mm., whorls 5½.

Oahu: Palolo and Halawa, a variety in Waimano.

Amastra breviata BALDWIN, Proc. A. N. S. Phila., 1895, p. 231, pl. 11, f. 41, 42.—*Achatinella breviana* BALDWIN, Catalogue, 1893, p. 8, name only.

The type specimen is figured, figs. 17, 18. In some others of the type lot there are no hydrophanous markings. It is hardly distinguishable from *A. pellucida*, although Mr. Baldwin states that the animals differ. Some difference in pigmentation of the soft parts may reasonably be expected in view of the variation in color of the shells. In stating that this species and *A. pellucida* are without epidermis, Mr. Baldwin

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was in error, for a thin cuticle exists, as in all the Metamastræ, though there is no dull or dark outer layer.

A. p. breviata, while connecting with *A. pellucida* through various shells of intermediate shades of brown, is also, on the other hand, quite as closely connected with *A. textilis*. Typically *breviata* is more obese than *textilis*, a little thinner, a trifle more roughly wrinkled, less glossy, and it often has hydrophanous bands; but I would not care to attempt the separation of a mixed lot.

In a series from Waimano in coll. C. M. Cooke the color is rich red-brown, varying in intensity. One shell has an interrupted buff line near the suture, and a small yellow area at the axis, the others being one-colored. The shell is thinner than in typical *breviata* (pl. 30, fig. 15).

Probably *A. breviata* will be found to range from Palolo to Waimano. In its characters and distribution it lies between *textilis* and *pellucida*, though of course separated from the latter by the arid inter-montane belt.

17. A. IRWINIANA Cooke. Pl. 30, fig. 16.

"The shell is minutely (though distinctly) perforate, dextral, globosely conical, with *slightly concave outlines*, thin, distinctly irregular and closely striate with lines of growth, not glossy, the upper whorls and the base of the last whorl light brown with a slightly yellowish tinge, the upper portion of the last whorl of a dark chestnut. Spire slightly concavely conic, apex acute. Suture simple, well impressed. Whorls 6¼, the embryonic slightly swollen, the fourth and fifth slightly flatter, the last convex, tumid, with an almost obsolete angle at the periphery, tapering towards the base. Aperture rather large, bluish within, in the form of a slightly oblique sector of a circle, very slightly oblique. Columella straight; columellar fold almost median, rather large, thin and slightly oblique. Outer margin of the lip thin, slightly thickened within, erect, regularly curved, forming an angle with the base of the columella; columellar margin thin, reflexed above the umbilicus. Umbilicus minute, semicircular. Length 11.2, diam. 7.2, length of ap. (diagonal) 5.9 mm." (*Cooke*).

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Oahu: Summit of Lanihuli, at 2700 ft. (Spalding). Type no. 16633, Bishop Museum.

Amastra irwiniana COOKE, Occas. Papers B. P. Bishop Mus., iii, p. 17 [213], f. 3 (July 24, 1908).

"This species is undoubtedly related to *A. breviata* Baldwin. It is, however, smaller, with a more acute and slightly concave spire, and the arrangement of its color is different.

"A second specimen has the following measurements: length 10.8, diam. 6.9 mm." (*Cooke*).

Mt. Lanihuli stands between the heads of Nuuanu and Kalihi valleys, at the head of Kapalama. The locality is therefore within the area recorded for *A. breviata*. The embryonic whorls are much more sharply striate than in *A. breviata*, more resembling fresh specimens of *A. cornea*, which also agrees in the shape of the spire. *A. irwiniana*, here figured from the type specimen, seems rather isolated in its group. Dedicated to Mr. Irwin Spalding.

18. A. ALBOLABRIS (Newcomb). Pl. 30, figs. 21, 22, 23.

"Shell conically ovate; apex acute; whorls 6, rounded, not margined; aperture ovate; columella short, plicately toothed; lip semilunar, thickened and white; color dark umber with a yellow sutural line; within bluish white. Length fourteen-twentieths, diam 6½-twentieths of an inch" (*Newc.*).

Oahu: Waianae (Newcomb); Lihue (Gulick); Kalihi and Kapalama (Baldwin); Nuuanu (C. M. Cooke). Co-types in coll. Newcomb and British Museum.

Achatinella albo-labris NEWC., P. Z. S., 1853, p. 149, pl. 24, f. 56.—*A. albolabris* Newc., PFR., Monogr., iv, 556.—BALDWIN, Catalogue, p. 8.—*Achatinella nucleola* Gld., REEVE, Conch. Icon., v, pl. 5, f. 39 (1850), not of Gould.

This species certainly inhabits both of the Oahuan ranges. It was first taken in the Waianae range, but it has also been taken in some numbers in the eastern range, in the adjacent valleys Kalihi, Kapalama and Nuuanu. Numerous specimens from Newcomb, Gulick and Cooke are before us.

The shell is solid, nearly or quite imperforate, covered with a thin, glossy, yellow cuticle, the calcareous layer below it

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being reddish-brown in the spire or throughout, or the last whorl may be almost white under the cuticle. The general tone is therefore quite variable, but the pale yellow tint generally predominates on the last whorl. Sometimes it is variegated with narrow spiral bands of olive-yellow and brighter yellow. These approach the *reticulata* type of coloring. There is almost always a narrow pale band below the suture. The embryonic whorls are very finely, rather sharply striate, the last one generally having the striæ interrupted by spiral lines. The later whorls have coarse wrinkle-striæ, usually cut by spiral incised lines, but these may be very weak, or even scarcely perceptible. The interior is white or pale flesh-tinted; and the lip has a strong white callous rib within. The parietal callous is thick and opaque. Lihue shells (fig. 23) measure:

Length 16.1, diam. 9, aperture 8 mm.; 6⅓ whorls.

Length 13.8, diam. 8.2, aperture 7 mm.; 5½ whorls.

In Nuuanu shells (pl. 30, figs. 21, 22) the cuticle is stronger than in those from the Waianae range; color a rather bright yellow, sometimes with interrupted or stippled whitish bands; upper whorls of the spire dull red-brown as usual. A shell normal in shape and a very long one are figured.

A. albolabris is related to the much darker and smoother *A. textilis*, but it also has characters of the more typical forms of the *reticulata* series, as shown by the occasional development of a variegated coloration, the spiral incised lines and rather strong striation of the later whorls, reminding one of *A. venusta*, which is perhaps its nearest relative.

19. A. SUBROSTRATA (Pfeiffer).

"Shell imperforate, dextral, ovate-conic, solid, irregularly striate, a little shining; brown, clouded with tawny. Spire swollen-conic, the apex rather acute. Whorls 6, the first 4 scarcely convex, the last rounded, about two-fifths the total length. Columellar lamella nearly basal, acute, oblique. Aperture slightly oblique, irregularly semielliptical, angular at the columella, as if extended into a sort of beak. Peristome unexpanded, white-lipped within, the right margin

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somewhat spreading, columellar margin little dilated, adnate. Length 15, diam. 8 mm." (*Pfr.*).

Sandwich Is. (Frick, in Cuming coll.); Oahu (Hartman).

Achatinella subrostrata PFR., P. Z. S., 1859, p. 31; Monogr., vi, p. 181.—*L[abiella] subrostrata* Pfr., HARTMAN, Proc. A. N. S. Phila., 1888, p. 43.—*Amastra subrostrata* Pfr., SYKES, Fauna Hawaiiensis, p. 345.

Pfeiffer remarks: "related to *A. albolabris* Newc." Hartman, who obtained specimens in London, states that it "equals *albolabris* Newc., and is an *Amastra*," though he gives it place in his list as a separate species of *Labiella*. Mr. Sykes, who has seen the type, writes: "It may possibly be an elongate variety [of *A. albolabris*], but I doubt it." It has not been figured.

20. A. SERICEA (Pfeiffer).

"Shell imperforate, dextral, ovate-conic, solid, rather rudely striate, minutely granulate-decussate by spiral striæ, silky, deep brown; spire convexly conic, rather acute; whorls nearly 6, convex, paler at the suture, the last two-fifths the total length, whitish around the columella, columella provided with a short, compressed, oblique lamina. Aperture oblique, elliptical; peristome simple, unexpanded, the right margin nearly semicircular, joined in an angle with the calloused columella. Length 17, diam. 9⅓ mm." (*Pfr.*).

Sandwich Is. (Frick, in Cuming coll.).

Achatinella sericea PFR., P. Z. S., 1859, p. 31; Monographia, vi, 179.—*Amastra sericea* Pfr., PSE., P. Z. S., 1869, p. 650.—SYKES, Fauna Hawaiiensis, p. 343.

This species seems to be known from Pfeiffer's description only, though Mr. Baldwin has recorded it with doubt from Waialua, Oahu. The rude striation, spiral striæ and angular junction of basal lip and columella indicate that the species belongs to the group of *A. transversalis*, having perhaps some resemblance to large, conic and dark forms of *A. reticulata*. Compare also *A. davisiana*. The type seems to be lost, as Mr. Sykes remarks that it is unknown to him.

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21. A. DAVISIANA Cooke. Pl. 31, fig. 1.

"The shell is perforate, dextral, subconic, with slightly convex outlines, obtusely and faintly angular at the periphery, with a somewhat flattened base, rather solid, nearly smooth, distinctly and almost regularly striate just below the sutures, slightly glossy, dark reddish-brown, with an indistinct broad dark band just above the periphery and continued on the spire just above the sutures. Spire almost conic, apex very obtuse. Suture minutely crenulate, scarcely impressed, yellowish along its edge. Whorls 6¾, the embryonic rather large (for the genus), the rest increasing slowly and very regularly, almost flat, the last descending slightly near the aperture. Aperture small, subquadrate, oblique, bluish within. Inner margin of the columella slightly diagonal, outer margin nearly straight; columellar fold nearly basal, strong, thick, slightly oblique. Outer margin of lip thin, slightly thickened within, nearly straight above, curved below, forming something of an angle with the base of the columella; columellar margin thin, reflexed above the umbilicus. Umbilicus small, semicircular. Length 16.5, diam. 9.2, length of ap. (diagonal) 7.0 mm." (*Cooke*).

Oahu: About a mile from the summit of Konahuanui (Davis); summit of Konahuanui (Spalding). Type no. 16,454, Bishop Museum.

Amastra davisiana C. M. COOKE, Occasional Papers Bernice Pauahi Bishop Museum, iii, p. 19 [215], fig. 1 (July 24, 1908).

"I know of no species to which this is at all related. It is entirely distinct from any of the other species of *Amastra*. The blunt apex and very regularly coiled and almost flat whorls are very peculiar. The single type specimen was originally collected by Mr. Elmer Davis, about a mile from the summit of Konahuanui. Additional specimens were found later by Mr. Spalding at the summit. These are smaller, slightly darker, and have about ¼ less whorls. One of these (no. 16453, Bishop Museum) measures: length 14.4, diam. 8.5 mm." (*Cooke*).

A specimen from the type locality is figured, length 15.5,

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diam. 9 mm. While in some respects it resembles *A. decorticata* and *inflata*, the texture, short whorls, obtuse summit and downward-bent columellar lamella are features more like the *reticulata* group. Compare also *A. sericea* Pfr. It is an isolated species. The band mentioned in the description is not invariable, the shell figured having the last two whorls of a rich chestnut color, darkest at the base. Under the lens, fine, superficial and close spiral striæ may be traced on the last whorl.

22. A. THAANUMI n. sp. Pl. 38, figs. 1, 2.

The shell is *sinistral*, imperforate, moderately solid, oblong, having a somewhat silky luster. Spire widely conic with somewhat convex outlines and rather obtuse summit. Embryonic whorls marked with faint, very fine growth-striæ only; later whorls *distinctly striate* obliquely, the striæ fine and somewhat thread-like. Upper whorls purplish-brown with irregular whitish streaks, the last two whorls covered with a rich dark chestnut cuticle, yellowish next the suture, and deciduous in front of the aperture, showing a glossy light green under layer. Aperture rather oblique, livid or bluish white within, with a whitish callous rim within the dark-edged lip. Columella short, bearing a strong, triangular, downward-bent lamella. Parietal callus thin.

Fig. 1. Length 14.6, diam. 9.5, aperture 7 mm.; 5¾ whorls.

Fig. 2. Length 14.9, diam. 9.5, aperture 7.3 mm.; 6 whorls.

Oahu: Kaaawa (D. Thaanum).

Conspicuous for its sinistral coil. The only living specimen found is figured. Several dead shells, similar to fig. 2, were taken. These when wet are dull reddish-brown above the periphery, paler or whitish below it, the apex dark purple. By the character of its cuticle this species resembles some forms of *A. tristis*, but the obtuse summit and short, deep curve below the columellar lamella declare it a member of the *reticulata* series. Even if dextral, it would stand isolated from other known species. Named in honor of Mr. D. Thaanum. Co-types to be placed in the Bishop Museum.

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23. A. SOLIDA Pease.

"Shell dextral, imperforate, thick, long-ovate, whorls 6, convex, the last feebly inflated, more rarely rounded-angulate at the base, not quite half the length of the shell. Aperture broadly elliptical, subangular at the base. Columellar fold thick, subbasal, nearly transverse. Peristome rugose, calloused, the margins joined by a thick callus. Chestnut-brown, the apex red-brown, aperture whitish. Length 15, diam. 8 mm.

"The peculiar callous deposit around the aperture distinguishes this species from its congeners" (*Pease*).

Oahu (Pease). Type in Pease coll., Mus. Comp. Zoology.

Amastra solida PSE., Journ. de Conchyl., 1869, p. 173.

An unfigured species of uncertain systematic position, not seen by us, and equally unknown to other authors.

24. A. VETUSTA Baldwin. Pl. 29, figs. 16, 17.

The shell is minutely rimate, oblong-conic, rather thick and solid. Being known from fossil examples only, it is whitish and without cuticle. Spire slightly conic, a little contracted towards the subacute apex. Whorls 6⅓, but slightly convex. First half-whorl smooth; next two whorls of the embryonic shell are sculptured with fine, deeply engraved, slightly arched longitudinal striæ. Subsequent whorls *rudely sculptured with rather coarse, strong and close longitudinal wrinkles*, which are *cut by a few irregularly placed spiral lines*, as if scratched on a soft surface. The aperture is hardly oblique, small, ovate. Outer lip is obtuse, strongly thickened within. Columella bears a subhorizontal lamella, rather small in front view, but very strong within, as seen in an oblique view in the mouth. The parietal callus is heavy, especially at the edge.

Length 13.3, diam. 8 mm.; length of aperture with peritome 6½ mm.

Length 14, diam. 8 mm.; aperture 6½ mm.

Oahu: Fossil at Punchbowl Hill, Honolulu.

Amastra vetusta BALDWIN, Proc. A. N. S. Phila., 1895, p. 233, pl. 11, f. 50.

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"This species was also discovered by Prof. Lyons. It occurs near the base of Punchbowl Hill, at an altitude of twenty or thirty feet above sea-level, in a conglomerate of volcanic tufa and sand cemented together with carbonate of lime. Prof. Lyons thinks the shells must have lived near the spot where they are now found embedded in the rock, as there is no satisfactory way to account for their transportation from any distance. If so, the conditions of climate when the shells flourished in that locality must have been quite different from those of the present time" (*Baldwin*).

A. vetusta shows the thickening of shell and rude sculpture usual in land shells living in arid places with little shade or cover. It is related to *A. transversalis* and *A. undata*, both of which are thinner shells, also differing in shape. It is not more "primitive" than the allied recent forms. The type is figured, coll. A. N. S. P.

25. A. RETICULATA (Newcomb). Pl. 29, figs. 2, 3, 4.

"Shell conically ovate; whorls 6, much rounded; suture moderate except at the junction of the last whorl, which is deep. Aperture small, ovate; columella short, with a plicate tooth, nearly transverse. Color brown or chestnut with white transverse lines and markings laid onto the epidermis in various patterns like lace-work or embroidery. Length twelve-twentieths, width seven-twentieths of an inch" [15x8.75 mm.] (*Newc.*).

Oahu: Waianae (Newcomb); Lihue (Gulick); Mt. Kaala (Thwing). Co-types in coll. Newcomb and British Museum.

Achatinella reticulata NEWC., P. Z. S., 1853, p. 148, pl. 24, f. 54 (1854).—PFR., Monogr., iv, 544.—BALDWIN, Catalogue, p. 9.—THWING, Orig. Descr., p. 159.—*Achatinella conspersa* PFR., P. Z. S., 1855, p. 7, pl. 30, f. 26; Monogr., iv, 544.

Newcomb's type was banded below the periphery, like fig. 3. The embryonic whorls appear smooth under an ordinary lens. Subsequent whorls have fine, unequal growth-wrinkles which are strongest below the suture. The aperture is but slightly oblique, flesh-tinted within. There is a strong white rib within the lip. The columellar lamella is well developed.

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The ground-color varies from light olivaceous-brown to reddish-brown, and is variously marked with white flecks and streaks in spiral or irregular patterns, sufficiently shown in the figures. Specimens from Lihue are figured; three measure:

Length 13.1, diam. 8.7, aperture 7 mm.; whorls 5½.
Length 13.8, diam. 8.1, aperture 7 mm.
Length 12.8, diam. 8.7, aperture 6.5 mm.

25*a*. *A. r. conspersa* Pfeiffer. Pl. 29, fig. 1.

"Shell imperforate, dextral, conic-ovate, rather thin, closely striate; deep brown, bespread with dirty-whitish spots forming angulated streaks. Spire convexly conic, the apex acute; suture simple. Whorls 6, the upper ones flattened, the penultimate more convex, the last about three-sevenths the total length, rounded. Aperture little oblique, sinuate-elliptical. Columellar fold subbasal, compressed. Peristome simple, unexpanded; no columellar margin. Length 18, diam. 10.5, oblique alt. of aperture 9, width 5 mm." (*Pfr.*).

Sandwich Is. (Frick, in Cuming coll.).

Achatinella conspersa Pfr., P. Z. S., 1855, p. 7, pl. 30, f. 26; Monogr., iv, 544.—Thwing, Reprints Orig. Descript., p. 159.

Unknown to us. Pfeiffer's description and figure are copied. It seems to differ from *reticulata* only by the larger size, and it may possibly be identical with *orientalis*. We follow Newcomb in subordinating the form to *A. reticulata*. Mr. Thwing reports *conspersa* from near Lihue, remarking that it approaches *A. reticulata*. His translation of Pfeiffer's description of the colors is faulty.

✓ 25*b*. *A. reticulata dispersa* n. subsp. Pl. 29, figs. 5, 6, 7.

Dark chestnut with a columellar yellow patch, profusely variegated with light yellow or white, in broken streaks, stippled spiral lines or short vermicular spots, frequently absent below the periphery, or rarely markings may be absent. Last whorl sometimes having a light brown ground. Spire short, *obtuse*, with *very convex outlines*. Embryonic whorls

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lower and broader than in *reticulata*, smooth. Aperture flesh-colored within, with a white submarginal callus. Columellar fold not so strong and horizontal as in *reticulata*.

Length 17, diam. 9.7, aperture 9 mm.; 5½ whorls (type, fig. 5).

Length 15.5, diam. 9, aperture 8.1 mm.; 5¾ whorls.

Length 15.9, diam. 10, aperture 9 mm.; 5½ whorls.

Oahu: Waianae (Baldwin, Cooke).

The summit is remarkably blunt in this form, and the outlines of the spire typically far more convex than in *A. reticulata*, yet there are some specimens intermediate in this feature. The axis is imperforate in all the adult shells seen. It is an extremely variable form. Two "dead" shells in the Boston Society collection from Waianae (out of no. 1759 Cooke coll.) showing extremes of contour in adult individuals, measure:

Length 18.7, diam. 10.1, aperture 9 mm.; 6 whorls.

Length 13, diam. 8.2, aperture 7 mm.; 5½ whorls.

25c. *A. reticulata orientalis* Hyatt & Pilsbry, n. subsp. Pl. 29, figs. 8, 9, 10, 11.

This includes the shells commonly referred to *reticulata* which occur in the valleys of the eastern range. These differ from true *reticulata* in being somewhat stouter and in having blunter apices due to the more rapid widening of the shells. Some shells, however, show apices almost as sharp as in true *A. reticulata*. Some have a uniform brown pattern, but most of the shells are reticulated or flecked with interrupted light bands as in *reticulata*, and are smooth in texture. There is no correlation between the colors and the shapes of the shells. The columellar fold is very strong and subhorizontal; lip-rib thick. Apical sculpture as in *A. reticulata*.

Length 15, diam. 8.1 mm.; whorls 5¾.

Length 13.5, diam. 9 mm.; whorls 5½.

Oahu, eastern range: Wahiawa (Gulick), types no. 92641 A. N. S. P.; Kahana (C. M. Cooke coll.).

This may possibly be *A. conspersa* Pfr., but the figure of that shows a more pointed apex. *A. r. dispersa* has not quite

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so strong a columellar fold as *orientalis*, but it differs in little except geographic range. A specimen in coll. C. M. Cooke shows that this form extends over the crest of the range into Kahana valley.

25*d*. *A. reticulata errans* n. subsp. Pl. 29, figs. 12, 13.

Shell with the general shape of *A. reticulata*, but thinner, less obese, with thinner or sometimes scarcely any thickening within the lip or on the columella, aside from the lamella, which is thin but broad. Axis rimate in two out of three examples. Color chestnut of varying shades, with spiral lines of yellow spots, sometimes many (fig. 13), sometimes very few or scarcely noticeable.

Length 12.2, diam. 7.3, aperture 6.5 mm.; whorls 5¼.

Length 13, diam. 7.5, aperture 7 mm.; whorls 5⅓.

Waimano. Types no. 1133 C. M. Cooke coll.; also Kahana.

A small race, the thin texture of which is probably due to insufficient supply of lime. It occurred with a thin form of *A. breviata*. Two shells from Halawa, on the north side of the range some distance northwest of Waimano, are similar but slightly more solid. One is stippled with buff on an olive-yellow ground, the other red-brown with indistinct continuous lighter lines.

26. A. COOKEI n. sp. Pl. 38, figs. 4, 5.

The shell is narrowly perforate, oblong-conic, moderately solid, *glossy*, without trace of dull or deciduous cuticle. Whorls very weakly convex; outlines of the spire somewhat convex, becoming straight near the apex. Embryonic whorls faintly, finely striate (somewhat worn), following whorls marked with slight growth-lines, the last two having short, irregularly developed folds below the suture. The spire is reddish-brown; penultimate and last whorls profusely variegated with short, forwardly-descending yellow markings and oblique streaks along growth-lines, and becoming brown behind the lip. Two imperfect bands of the dark ground-color are visible. *Aperture small*, purplish within, the outer lip thin. Columellar margin brownish, expanded above, bearing

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a very strong but thin subhorizontal lamella. Parietal callus thin. Length 16.7, diam. 8, length of aperture 6.5 mm.; 7 whorls.

Oahu: Moanalua (Irwin Spalding).

This species has the coloration and texture of *A. reticulata*, but is notable for its slender contour, rather narrow summit and small aperture. The pattern will probably be found variable, as in allied species. Type to be deposited in the Bishop Museum; collected by Mr. Irwin Spalding and received through Dr. C. Montague Cooke, whose name the species bears.

27. A. TRANSVERSALIS (Pfeiffer). Pl. 31, figs. 2, 3, 4, 5.

"Shell subrimate, ovate-conic, solid, closely striate, somewhat decussated with distant, spiral, impressed lines; blackish-red, covered with a tawny-gray epidermis interrupted in spots and bands. Spire inflated-conic, acute. Whorls 6, slightly convex, the last two-fifths the total length. Aperture a little oblique, sinuate-oval. Columellar fold lamelliform, subbasal, almost transverse. Peristome unexpanded, whitish within or delicately lipped with rose. Length 12, diam. 6, aperture 5⅓x3 mm." (*Pfr.*).

Oahu (Frick, in Cuming coll.). Southeastern end of the main range in Keawaawa (Baldwin, Gulick), and Kuliouou valleys (Gulick).

Achatinella transversalis PFR., P. Z. S. London, 1855, p. 204; Monographia Hel. Viv., iv, 551.

The embryonic whorls are dark red-brown, very densely and finely striate vertically, and after the first whorl are decussated with very fine spiral lines. The last whorl has irregular vertical striæ, cut by incised spirals, which may be deep, strong and numerous or few and weak, sometimes so lightly marked that mere vestiges may be traced with difficulty. The ground-color is a rich dark red-brown, more or less covered by the whitish tracery which is wonderfully varied in pattern. Rarely the ground is a very light tint of brown, on which the creamy markings show but faintly. The interior is ordinarily dark flesh-colored, with a wide and moderately

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thick border within the lip. The axis is rimate or imperforate. Specimens from Keawaawa measure:

Length 13.2, diam. 6.1, aperture 5.8 mm.; 6 whorls.

Length 12, diam. 6, aperture 5 mm.; 6 whorls.

Length 12, diam. 6.5, aperture 5.2 mm.; 5¾ whorls.

Length 10.5, diam. 6.1, aperture 5 mm.; 5½ whorls.

By its embryonic sculpture, coloration and the spiral incised lines, this beautiful little snail is related to *A. undata* Baldw. It is not very closely allied to *A. reticulata* Newc., with which Newcomb united it. One of us (Hyatt) considered *transversalis* to belong to *Amastrella*, near *brevis, pulla* and *pusilla*. Figured from Keawaawa examples. As the type locality is unknown, we may consider this place as such. It is said to be now extinct.

28. A. CAPUTADAMANTIS n. sp. Pl. 30, figs. 19, 20.

The shell is cylindric-oblong, rather thin, the penultimate whorl nearly equal to the last in diameter; spire consequently bulging below, then rapidly tapering in a short cone. The surface is finely striate axially, the striæ cut on the last two whorls by incised spiral lines (sometimes weak or nearly effaced). Whorls 5¾ to 6, slightly convex, the last compressed laterally. Aperture small, semioval, angular at both ends. Outer lip obtuse, thickened within; columellar lamella small, situated near the base. Columellar lip reflexed and adnate, the axis imperforate or having a short, narrow crevice. Being fossil, the shells are white and chalky.

Length 14, diam. 7.1, aperture 6 mm.

Length 14.5, diam. 7.3, aperture 6 mm.

Length 13.8, diam. 6.3, aperture 5.8 mm.

Oahu: Diamond Head, near Honolulu, in a Pleistocene or Holocene deposit. Types no. 104687 A. N. S. P., collected by C. Montague Cooke, Jr.

Undoubtedly a member of the *A. textilis* and *transversalis* group, but much less robust than the cylindric forms of the recent fauna and with a smaller aperture. It is more cylindric than *A. transversalis*, which occurs farther east and on the main range.

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29. A. UNDATA Baldwin. Pl. 29, fig. 14.

The shell is imperforate, globose-ovate, moderately solid; dark reddish-brown, with broad, irregular, light yellow stripes on the last two whorls, zigzag below the periphery, more or less confluent above it, and preceded by scattered whitish spots and dashes on one or two earlier whorls. Spire straightly conic, the whorls but slightly convex; embryonic shell rather sharply, finely striate; later whorls *deeply and finely striate, the striæ cut by several incised spiral lines* in the peripheral region and above it. Aperture subvertical, flesh-colored within; a white callous rim within the lip. Columellar fold broad and subhorizontal. Length 19, diam. 12.1, length of aperture 10.2 mm.; 6 whorls.

Oahu: Nuuanu (Baldwin); Moanalua (C. Montague Cooke).

Amastra undata BALDW., Proc. A. N. S. Phila., 1895, p. 230, pl. 11, f. 39.

This species, here described and figured from the type, no. 65722 A. N. S. P., according to Mr. Baldwin "is very rare and local in its distribution. Its principal features are the prominent rib-striæ and the beautiful undulating markings of light and dark chestnut-brown." The strong spirals cutting the rib-striæ are also very characteristic. It differs from *A. reticulata* by the sharp striation of the embryonic shell, etc. The Moanalua specimen (Cooke coll.) agrees fully with the type from Nuuanu. A young one, also in the Cooke collection, is very broad, and angular peripherally. The striped coloration commences at the beginning of the third whorl. The embryonic whorls are not well described by the term "sulcated," used by Mr. Baldwin. In the terminology used in this monograph they would be termed sharply and finely striate, but on the last embryonic whorl there is a low, indistinct undulation under the fine striation.

30. A. BADIA Baldwin. Pl. 29, figs. 15, 18, 19.

"Shell dextral, imperforate, rather thin, elongately ovate-conic; surface shining, sculptured with delicate, rather close thread-like rib-striæ in the direction of the growth-lines; em-

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bryonic whorls radiately sulcated. Color dark chestnut-brown with light brown zigzag or undulating lines and markings. Whorls 6½, slightly convex; suture moderately impressed. Aperture oval, a trifle oblique, livid white within, exhibiting the brown color of the exterior; peristome acute, very lightly thickened within; columella white, flexuous, abruptly terminating in a thin, slightly arched lamellar plait. Length 20½, diam. 10½ mm." (*Baldwin*).

Oahu: Ewa (Baldwin); Moanalua, Aeia and Waimano (C. M. Cooke).

Amastra badia BALDW., Proc. A. N. S. Phila., 1895, p. 230, pl. 11, f. 40.

In color, pattern and sculpture of the later whorls this form resembles *A. undata*. Whether there are spiral decussating lines on the last whorl of the type specimen was not stated by Baldwin, but they are present in one specimen examined from Moanalua, wanting in another. In those from Waimano the spirals are either very faint, hardly noticeable, or wanting. *A. badia* differs from *undata* by its embryonic sculpture and the less obese, more ovate shape.

The columellar lamella penetrates two whorls. The axis is imperforate in the adult and later neanic stages, but in the half-grown shell there is a rather widely open umbilicus, width about 1 mm.

The embryonic whorls (pl. 29, fig. 19) are much more strongly sculptured than in *A. undata*. After the smooth initial half-whorl, coarse vertical ribs appear, changing to an irregular coarse malleation on the last half of the second whorl. Then short, rather coarse protractive ribs appear below the suture, while above the lower suture there is another system of smaller, retractive folds, the two systems interfering about the middle of the whorl. The third whorl has fine growth-lines only, and the color-pattern appears as a few white spots and irregular stripes. The ground-color of adults is dark red, upon which there are yellow streaks or spots. In some shells from Aeia the last whorl has a yellow suffusion, faintly mottled with dark. The shell is quite thin.

Fig. 15 is a copy of Baldwin's type figure; figs. 18, 19 are immature shells from Waimano. Type in Baldwin coll.

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Series of A. cornea.

Acutely or acuminately ovate Amastras, with the spire slender, attenuate, being more or less contracted near the apex; embryonic whorls very finely striate vertically and usually with traces of spirals (pl. 31, fig. 12). Cuticle thin, persistant, the last whorl without a dull outer or deciduous coat. Columellar lamella subhorizontal.

Rather small, long-spired derivatives of the *reticulata* series, two species occurring in the Waianae range, two others, rare and local, in the eastern range.

It is quite possible that the eastern species are divergent forms of the *reticulata* series, related to *transversalis, textilis, irwiniana*, etc., and not directly allied to those of the Waianae range. I am unable to settle this point.

Key to Species.

a. Lip strengthened by a strong white internal rim; spire brown, the last whorl opaque-whitish, often malleate; Waianae range. *A. crassilabrum*, no. 32.

a^1. Lip thin or very slightly thickened.

b. Spire rapidly tapering from the last whorl.

c. Shell brown, or with the last whorl pale; parietal callus thin; Waianae Mts. *A. cornea*, no. 31.

c^1. Shell olivaceous; parietal callus thick; eastern range. *A. æmulator*, no. 34.

b^1. Penult. whorl rather large, the spire wider below; fossil, eastern range. *A. subcornea*, no. 33.

31. A. CORNEA (Newcomb). Pl. 31, figs. 9, 10, 12, 13, 14.

"Shell irregularly, acutely conical, the apex pointed; last whorl inflated; thin, corneous, with minute longitudinal striæ; whorls 7, rounded; aperture subovate; lip thin, translucent; columella straight, white, and armed with a transverse plaited tooth. Color uniform dark horn, columella and tooth white. Length ten-twentieths, diam. five-twentieths of an inch. Habitat ———?" (*Newc.*).

Oahu: Lihue (Gulick); below Kaala (Perkins); Kaala and

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Waianae (C. M. Cooke); Waianae (Baldwin). Co-types in coll. Newcomb and British Museum.

Achatinella cornea NEWC., P. Z. S., 1853, p. 141, pl. 23, f. 32.—*Amastra c.*, SYKES, Fauna Hawaiiensis, p. 335.

This rather thin shell has the concavely tapering spire and somewhat bulbous last whorl of *A. crassilabrum*. The convex embryonic 2½ whorls show an elegant sculpture of extremely fine, sharp and close longitudinal striæ. The later and last whorls are rather lightly marked with growth-wrinkles, but are not malleated as *A. crassilabrum* usually is. The cuticle is rather glossy, with no dull outer layer. Color brown or slightly reddish-brown, sometimes having a yellow border below the last turn of the suture. Newcomb's figure, as well as specimens from him we have seen, show that he was rather wide of the mark in calling this species "corneous." The lip has only a thin callous rim within, and the parietal callus is also thin. Some shells are rather openly perforate, others being imperforate. Length 13, diam. 7, aperture 5.9 mm.; 6¾ whorls. The smallest adult seen is 11 mm. long.

In a series from Waianae (Baldwin) the last whorl in old shells is light yellow with some brownish streaks; the penultimate whorl has a yellow subsutural line, the spire being otherwise rather dark brown. The aperture has the thin lip of *cornea*, with hardly any internal callous rim. Specimens measure:

Length 17.5, diam. 8.5 mm.; whorls 7⅓.

Fig. 14. Length 17.5, diam. 8 mm.; whorls 7½.

Fig. 13. Length 16, diam. 7.9 mm.; whorls 7.

An embryo from one of this lot (pl. 31, fig. 12) is long, rimate, with the periphery merely subangular, and the columellar fold very weak and oblique.

The shells from Kaala in C. M. Cooke collection are uniform dark red-brown, typical in shape.

A lot of three shells from Waianae in the Cooke coll. have the spire very light brown, last whorl light olivaceous-yellowish. One of these is figured, pl. 31, fig. 10.

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32. A. CRASSILABRUM (Newcomb). Pl. 31, figs. 6, 7, 8.

The shell is acuminately ovate, solid; the embryonic whorls are purple-brown tipped with white, *spire brown, last whorl opaque, white* or cream-white. The spire has slightly *concave* outlines, being slender above. The embryonic whorls are quite *convex* and are very finely striate, generally worn smooth in adults; subsequent whorls of the spire marked with fine, irregular growth-lines only; the *last whorl generally malleated* throughout, or only in the last half. Aperture oblique, white within. Peristome somewhat obtuse, with a light brown edge, and bordered by *a strong callous rib within.* Basocolumellar junction somewhat spout-like. Columellar lamella strong. Parietal callus rather thick, subtransparent. Axis rimate or closed.

Length 14.5, diam. 7.8, aperture 6.5 mm.; 6⅓ whorls. (Lihue.)

Length 15, diam. 8, aperture 7 mm.; 6⅓ whorls. (Lihue.)

Length 12.5, diam. 6.7, aperture 5.9 mm.; 6 whorls. (Lihue.)

Length 15, diam. 7.5 mm.; whorls 6 (Newcomb).

Oahu: Waianae (Newcomb, Baldwin); Lihue (Gulick); near Mt. Kaala (Thwing). Co-types in coll. Newcomb and British Museum.

Achatinella crassilabrum NEWC., P. Z. S., 1853, p. 141, pl. 23, f. 31 (1854).—THWING, Orig. Descriptions, etc., p. 157.

A very distinct, easily recognized species. The brown color of the spire often extends over the front of the last whorl. There is generally a light line just above the suture on the penult. whorl. Many specimens from two localities, including specimens from Newcomb, show but little variation. The related *A. cornea* differs in the color and sculpture of the last whorl. Very rarely traces of spiral incised striæ are visible in recent specimens. They are rather well developed in fossil specimens from Waianae in Dr. Cooke's collection. These shells also have the outer lip very thick, like *A. vetusta* Baldw.

33. A. SUBCORNEA Hyatt and Pilsbry, n. sp. Pl. 31, fig. 11.

This is a subfossil shell smaller than cornea, but with a

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similar attenuated and biconcave outline near the apex. It is similar to *Leptachatina* in the aspect of the shell owing to the rapid growth of the three last volutions. The apex, however, has not the blunted aspect of *Leptachatina*, nor the disproportionate rate of growth between the nepionic and neanic stages observable in that genus. The aperture is narrow owing to the contraction of the last volution. The columella is perforated, but the opening is not large and is almost closed in some shells. The surface has coarse ridges of growth. The nepionic stage has fine, transverse ridges of growth. The characters in all respects are intermediate between *cornea* and those of the more primitive shells of the *Brevis* series on the island of Oahu and make it highly probable that this is a connecting species.

Oahu: Fossil, near the base of Round Top, towards Rocky Hill, where the Manoa road enters the valley back of Punahou. Type no. 1749 C. M. Cooke coll.; also 104689 A. N. S. P., and in Boston Soc. coll. no. 13397.

Hyatt's description is given above, and one of the types is figured. The non-impressed suture and the sculpture are other points of agreement between this species and *A. cornea*, from which *subcornea* differs chiefly by the more prominent penultimate whorl, which gives the spire a wider shape than that of *A. cornea*, approximating somewhat to the contour of *A. transversalis*. The apical sculpture, very well preserved in no. 13397 Boston Soc. coll. (from no. 1747 Cooke coll.), is like that of *A. cornea*, the embryonic whorls being very finely and closely striated, the striæ arcuate. *A. transversalis* has similar but straighter striæ. It is a fossil form, from a deposit of unknown age, probably Pleistocene, exposed in a road cutting.

Length 12.5, diam. 6.5, aperture 5.3 mm.; 6½ whorls.

Length 10.8, diam. 5.3, aperture 4.5 mm.; 6⅓ whorls.

If this species is really a member of the *cornea* series, it is widely separated from its allies.

34. A. ÆMULATOR n. sp. Pl. 38, fig. 7.

The shell is narrowly perforate, ovate-pyramidal, rather

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solid. Outlines of the spire are nearly straight below, becoming a little concave near the summit; whorls slightly convex, short; embryonic 2½ are dull purplish, very finely, regularly striate where unworn; subsequent whorls irregularly wrinkle-striate, the cuticle at first light olive, on the last two whorls olive-brown; rather glossy; where worn away showing a dull gray and purplish-brown calcareous layer. The aperture is small, slightly oblique, dull purplish-gray within, paler and just perceptibly thickened near the lip. Columella short, thick, whitish, bearing a subhorizontal lamella. Parietal callus very thick, its edge forming a ledge connecting the lip-ends. Length 15.5, diam. 8.6, aperture 6.9 mm.; whorls 7.

Oahu: Kahauiki (D. Thaanum). Type to be deposited in the Bishop Museum.

This species is related to *A. crassilabrum*, from which it differs by its color, the less attenuate spire, much less thickened lip, and by the thick parietal callus of old individuals. Kahauiki is a short valley between Kalihi and Moanalua.

Section AMASTRELLA Sykes.

See p. 151.

Series of A. inflata.

Amastræ with finely striate or nearly smooth embryonic whorls (sometimes irregularly costate in *A. tristis*); the junction of columellar and basal margins of the aperture rounded (not subangular or spout-like). The shell is more or less completely covered with a dull or dark, in part transient, sometimes very thin cuticle, under which it is not banded.

These shells agree well with the typical Kauaian Amastrellæ except in the development of a more or less conspicuous dark outer layer of cuticle, a character showing an advance beyond typical *Amastrella*. This cuticle is not mottled or figured with angular streaks, as it is in typical *Amastra*. The group differs from *Metamastra* by the more widely rounded margin below the columellar lamella, which is smaller and less horizontal.

The *inflata* series contains the least specialized of the

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Oahuan Amastræ. The other groups, *Metamastra* and *Paramastra*, have diverged further from the ancestral stock.

One species, *A. tristis*, sometimes has rather coarse low ribs on the second embryonic whorl, the apex being more conic than in most other species, not unlike that of *Kauaia*. *A. tristis*, together with some other Oahuan species, was grouped with the Molokaian *pullata* and *violacea* series by the senior author (in MS.). The shape of the embryonic whorls and the maculation of the neanic whorls in many individuals are like *A. badia*; the incised spiral striæ are also characteristic of *undata, transversalis* and others of the group to which *badia* belongs; so that *A. tristis* seems to be a somewhat generalized or synthetic species; yet its chief relationship is with the *inflata* group.

35. A. RUBENS (Gould). Pl. 32, figs. 16, 17, 19, 20, 21.

"Shell elongate-ovate; thick; straw-colored, the apex chestnut, anterior end reddish. Whorls 6, convex; suture impressed; covered here and there wth brown epidermis. Aperture ovate; lip simple, thickened within, roseate, the throat white; fold thin; imperforate. Length ¾, diam. ⅖ of an inch. A plain species, but well marked by its colors, especially by that of the aperture" (*Gld.*).

"Animal dark slate, as long as the shell, tentacles black, bottom of foot and mantle brown. Excessively timid and lives buried under leaves and other decaying vegetation" (*Newcomb*).

Oahu, Waianae range: West mountains (Newcomb); Waianae (Cooke, Baldwin); Kaala (Baldwin); Kukuiala and Mokuleia (Gulick). Varieties in the eastern range, see below.

Achatinella rubens GLD., Proc. Bost. Soc. N. H., ii, Jan. 1845, p. 27.—PFR., Monogr., ii, p. 240; iii, 459; iv, 552; vi, 180 (exclusive of var. *b*, = *A. mastersi* Nc.).—REEVE, Conch. Icon., vi, pl. 6, f. 42*b*.—NEWCOMB, Ann. Lyc. N. H. of N. Y., vi, p. 314.—BALDWIN, Catalogue, 1893, p. 9.

The first half-whorl is smooth; then very fine, sharp and close and weakly arcuate longitudinal striæ appear, continuing for two whorls, after which comparatively coarse but

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low wrinkles of growth set in. The embryonic shell seems to comprise almost 3 whorls. It is dark brown, or when worn, purplish-brown. The rest of the whorls of the spire have rather coarse wrinkles below the suture, leaving the rest of the whorls and the whole last whorl, nearly smooth. Four or five upper whorls are reddish-brown, the last whorl or two are pale red-brown or whitish under a thin, glossy, yellow or flesh-tinted inner cuticle, which is more or less covered by a brown (blackish-brown or olivaceous-brown) outer layer, always worn off ventrally, and either rather well preserved (figs. 19-21, Mokuleia), or remaining in shreds (fig. 17, Waianae) or almost entirely lost (fig. 16, Kukuiale). The interior of the basal and outer lips is typically rose-colored, but sometimes it is bluish-white.

Length 19, diam. 9.1, aperture 8 mm.; whorls 6⅓.

Length 17.5, diam. 9.1, aperture 8.1 mm.; whorls 6.

A. rubens differs from *A. elliptica* and the *textilis* group by its noticeably more conic and sharply striate embryonic whorls, and the greater number of whorls in the whole shell. The fine striation of the embryonic shell is usually more or less completely worn from adult shells.

Figs. 19 to 21 are from Mokuleia specimens, measuring:

Fig. 21. Length 18, diam. 9, aperture 8 mm.

Fig. 19. Length 17, diam. 9.1, aperture 7.9 mm.

Fig. 20. Length 15, diam. 9.2, aperture 8 mm.

A large specimen from Waianae, which we consider the type locality, is figured, pl. 32, fig. 17. Length 21 mm., 6½ whorls.

In a series from Kukuiala (pl. 32, fig. 16) the outer layer of cuticle is almost wholly wanting, leaving the shell whitish or yellowish with more or less pink suffusion, most pronounced on the latter half of the last whorl. The shells are rather robust. This form has been called var. *rubinia* Hyatt in MS.

Length 17.3, diam. 9.5 mm. (A. N. S. P. no. 92481).

Length 19, diam. 10.1 mm (U. S. Nat. Mus. no. 4710).

A. rubens unites features of *Amastrella* and *Paramastra*, and it may possibly belong to the latter group, near *A. intermedia*. It has here been associated with the *inflata* group

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chiefly on account of the well-developed outer cuticle. If this view be correct, it must be viewed as a recent immigrant in the Waianae range.

Herr Borcherding is hopelessly wrong in lumping *rubens* with *mastersi* Nc. His inference that the species ranges over three islands is consequently baseless (see Zoologica, xix, Heft 48 II, p. 117). The embryonic whorls are totally diverse in the two species.

35*a*. *A. rubens corneiformis* n. subsp. Pl. 31, figs. 17 (nat. size), 18.

The shell is subperforate, ovate-turrite, rather solid, somewhat glossy. Spire with slightly convex outlines in the lower part, straightened or a trifle contracted near the summit. Embryonic whorls brown, somewhat worn, but apparently with a weak sculpture of regular, arcuate striæ. Following whorls marked with growth-wrinkles, at first brown, whitish below the suture, changing on the penultimate whorl, becoming on the last whorl whitish, faintly brown-tinted. On the last half-whorl this ground-tint is largely covered by a smooth, dense, blackish-brown outer cuticle, in part deciduous. Aperture whitish within; lip thin. Columella straight, its edge abruptly triangularly dilated above; bearing a thin lamella in the middle. Length 16.5, diam. 8.6, aperture 7.1 mm.; 6⅔ whorls.

Oahu: Waianae. Type no. 1753 C. M. Cooke coll.

Much more slender than *A. rubens*, and having much the general appearance of *A. cornea*.

35*b*. *A. rubens castanea* n. subsp. Pl. 32, fig. 18.

A reddish-chestnut cuticle covers the whole surface, even the spire. It is yellowish below the suture and black behind the lip. The spire is a little attenuated near the summit. The interior has a faint roseate tint, nearly white. Length 17, diam. 9.5 mm.

Waianae. Types no. 1761 Cooke coll.; co-type no. 104690 A. N. S. P.

In the Cooke collection there is a series of stunted or de-

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pauperate specimens from Waianae, evidently from several colonies (nos. 1760, 1762, 1763), which agree in the main with *castanea*, but are rather smaller, down to 14 mm. long.

35*c*. *A. rubens kahana* n. subsp. Pl. 31, fig. 16.

Similar to *rubens* in shape, cream-colored under an olivaceous-brown cuticle which is partially deciduous; the nude upper whorls either white, fleshy or reddish. Outlines of the spire slightly convex. Peristome rose-tinted in individuals having the apex dark, white in others. Length 18.2, diam. 10 mm.; whorls 6½.

Kahana, on the north side of the eastern range. Types 1417 C. M. Cooke coll.

35*d*. *A. rubens infelix* n. subsp. Pl. 31, fig. 15.

Smaller, more shortly ovate than *A. r. kahana*, the spire slender near the apex, whitish under an olive-brown cuticle which becomes black behind the outer lip. The latter part of the last whorl is compressed peripherally, and swollen or obtusely subangular at the shoulder. Aperture white. Length 14.7, diam. 8 mm.; whorls 5½.

Kahana. Types 1491 Cooke coll.

This is apparently a depauperate form. It is just possible that varieties *kahana* and *infelix* are satellite forms of *tenuilabris* and *rubicunda* rather than of *rubens*, which should properly belong to the Waianae range.

36. A. SEMINIGRA n. sp. Pl. 32, figs. 8, 9, 11.

Apical whorls fleshy or purplish, fading on the last two whorls to light yellow, more or less covered with pitch-black cuticle, which may be in shreds throughout (figs. 8, 11), or nearly continuous except in front of the aperture (fig. 9, Waimano). Interior white or faintly pink.

Fig. 8. Length 21.2, diam. 10.3, aperture 9.5 mm.; whorls 6½.

Fig. 11. Length 17.5, diam. 9.2, aperture 8 mm.; whorls 6½.

Length 19, diam. 9.7 mm.

Waimano. Co-types no. 1131 Cooke coll., figs. 8, 11; also Wahiawa, no. 1416 Cooke coll.; also in coll. A. N. S. P.

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This species differs from *A. tristis* only by its narrower shape at all stages of growth. The apical whorls are worn, rather narrowly conic, and seem to resemble those of *A. tristis*. A specimen from Waimano, coll. Spalding, agrees with fig. 9 in the nearly continuous coal-black cuticle, but where removed in front of the aperture the under layer is a fine light orange-brown color. *A. seminigra* occurs on the same slope of the range northwestward of the area of *A. tristis*, which it resembles in characters other than the shape. In the closely related *A. rubens* of the Waianae range the spire is typically wider, not so strictly conic; but at one time one of us thought it must be ranked as a variety of *rubens*. The black cuticle and more rectilinear sides of the spire separate *seminigra* from *intermedia*.

37. A. TENUILABRIS Gulick. Pl. 31, fig. 19.

"Shell dextral, ovate-conic, hardly shining, somewhat roughly striated with growth-lines; white under a fulvous epidermis, which is generally worn off below the suture on the last whorl. Whorls 5½, a little convex. Aperture subquadrate, white, not as long as the spire; peristome thin; columella straight, provided with a small median fold; lips connected by a very thin callus. Length 15, diam. 8 mm." (*Gulick*).

Oahu: Pauoa (Frick, type loc.); Nuuanu (Cooke). Type in coll. Boston Society.

Amastra tenuilabris Gulick in GULICK and SMITH, P. Z. S., 1873, p. 83, pl. 10, f. 16.—PFR., Monogr., viii, p. 241.—*Amastra t.*, SYKES, Fauna Hawaiiensis, p. 345.

"The specimens received are reported by Dr. Frick to be from Pauoa, on Oahu; but there is some reason to believe that they could not have been found on Oahu. Its affinities are uncertain, but it may be allied to *Am. flavescens* Nwc., which is found on the island of Hawaii" (*Gulick*).

The original specimen of this variety, examined by Hyatt, is very close to *A. rubicunda* Baldwin. Gulick's shell agrees very closely with two shells from Nuuanu in the Cooke collection. The differences between this and *rubicunda* consist in the warmer hue of the latter and its usually but not invari-

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ably darker aperture. The growth-wrinkles are more pronounced through the wearing-off of the more friable periostracum in this species and the contrast of the brown remnants with the more opaque white of the middle layer. Gulick's type figure is copied in fig. 19 of plate 31.

The shells in the Cooke collection and U. S. Nat. Mus. (no. 4722*a*) differ from *rubicunda* chiefly in the colder color-tones, the aperture being whitish rather than pink, and the summit white, or in one specimen, purple. The spire is not so high as in typical *rubicunda*. Such differences as there are seem insufficient for specific distinction. Pauoa is a small valley immediately east of Nuuanu, and which divides the lower part of a ridge leading up to Konahuanui, the locality of *A. rubicunda*.

37*a*. *A. tenuilabris rubicunda* Baldwin. Pl. 32, figs. 12, 14, 15.

"Shell dextral, imperforate, rather solid, elongately ovate-conic; surface lusterless, striated with irregular growth striæ; embryonic whorls smooth. Color reddish, with traces of a deciduous, thin, brown epidermis. Whorls 7, slightly convex; suture well impressed. Aperture elongately oval, a trifle oblique, rather small, purplish-red within; peristome simple, thin, margined with dark purple; columella white with a purple tinge, flexuous, abruptly terminating in a thin, slightly curved lamellar plait. Length 19, diam. 9 mm.

"Animal, mantle brown, margin of a deeper shade. Foot brown, the superior portion almost black. The formula of the dentition is 18.10.1.10.18, according to H. Suter" (*Baldw.*).

Oahu: Konahuanui Mt. (Baldwin, type loc.); Nuuanu, Kalihi and Moanalua (C. M. Cooke).

Amastra rubicunda Baldw., Proc. A. N. S. Phila., 1895, p. 229, pl. 11, f. 38. — *Helicter* (*Amastra*) *rubicunda* Baldwin, Suter, Proc. A. N. S. Phila., 1895, p. 240, pl. 11, f. 54,56 (jaw and teeth).

The embryonic whorls are somewhat worn in the type lot of four specimens, no. 65719 A. N. S. P., but a few fine striæ are visible on the second and third whorls. The ground-color is light red, sometimes becoming fleshy-yellowish on the last

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whorl, where there is a thin outer layer of russet cuticle, more or less deciduous in front, and worn off before the aperture. Behind the lip the cuticle becomes much darker, dark reddish-brown with some blackish streaks. The interior is in color between rose and lilac, and the lip commonly has a black line at the edge. The last half of the last whorl is flattened peripherally and turgid a little distance below the suture.

Length 19.3, diam. 9, aperture 8.2 mm.; whorls 6½.

Length 18.1, diam. 8.9, aperture 8 mm., whorls 6½.

Length 17.1, diam. 8.5, aperture 7.5 mm.; whorls 6⅓.

While this shell resembles *A. variegata* of the Waianae range, at the opposite end of the island, it differs in the color of the aperture and it does not have so many whorls. It is hardly separable from *A. tenuilabris*, and in our opinion only a race of that species. Its recorded range is discontinuous, probably because of insufficient collections. *A. seminigra, A. rubens kahana* and *infelix* inhabit the eastern range west of the area of *A. rubicunda*, to which they are probably related, differing chiefly in their colder coloring. Most *rubicunda* have a particularly warm shade of chestnut. Specimens from the western valleys are generally smaller than the types, with the interior less deeply colored.

Length 17.2, diam. 8.5 mm.; 6⅓ whorls (Nuuanu).

Length 16, diam. 8.3 mm.; 5¾ whorls (Kalihi).

Length 15, diam. 9.2 mm.; 5¾ whorls (Kalihi).

Figures 12 and 15 are from co-types. Fig. 14 is a Nuuanu shell in the C. M. Cooke collection.

38. A. LUCTUOSA (Pfeiffer). Pl. 33, figs. 12, 13.

"Shell imperforate, dextral, oblong-conic, solid, striatulate, a little shining, bicolored. Spire inflated-conic, apex acute; suture crenulated. Whorls 6, the upper four black, nearly flat, the penultimate pale, more convex; last whorl about two-fifths the total length, pale tawny above, blackish below the periphery. Aperture a little oblique, sinuate-semioval, white within. Columellar fold laminiform, subbasal, triangular; peristome unexpanded, acute, black-edged. Length 16, diam. 8, aperture 7x3⅔ mm." (*Pfr.*).

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Sandwich Is. (Frick, in Cuming coll.). Western and northwestern Oahu: Waialee (Baldwin); Kawailoa and Kahuku (Gulick); Kahana (Cooke).

Achatinella luctuosa PFR., P. Z. S., 1855, p. 204 (Feb., 1856); Monogr., iv, 554.—BALDWIN, Catalogue, p. 9.—*Laminella luctuosa* BINNEY, Ann. N. Y. Acad. Sci., iii, p. 98, pl. 6, f. F.—*Amastra luctuosa* Pfr. var. *sulphurea* ANCEY, Proc. Malac. Soc. Lond., vi, June, 1904, p. 121, pl. 7, f. 9.

The type of *A. luctuosa* has not been figured, and we do not know that the typical form described by Pfeiffer has been rediscovered. Its habitat is unknown. Baldwin and Gulick have found a form differing in color, but which they referred to *luctuosa*, in western Oahu between the southwestern and northeastern ranges. It has been described as var. *sulphurea* by Ancey.

The Gulick collection (in A. N. S. P.) contains a set of "dead" shells from Kahuku (pl. 33, figs. 12, 13), the northwestern extremity of Oahu. The last whorl is very pale brown under a thin brown cuticle, which is persistent throughout or worn-off in front of the aperture, and darker behind the lip. The spire is pale violaceous or pale red-brown under more or less covering of cuticle. Specimens measure:

Length 14, diam. 9 mm.

Length 15, diam. 8 mm.; 6½ whorls.

Length 14, diam. 8 mm.; 6 whorls (fig. 13).

Length 15, diam. 7.8 mm.; 6 whorls (fig. 12).

The relationships of *luctuosa* are somewhat uncertain. It is an inornate shell with no decided characters, but does not seem closely related to any other species.

38*a*. *A. l. sulphurea* Ancey. Pl. 33, fig. 11.

"Shell similar to the type, but pale buff, uniform, near the aperture covered with shreds of pale brown epidermis. Length 15.5, diam. 9.5, length of aperture 7 mm. Waialae" (*Ancey*).

Specimens from "Waialei" in the Gulick collection are pale buff or the spire may be pale brown. The embryonic whorls are almost smooth. The upper part of the spire is slightly pinched in.

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Shells from Kawailoa are similar but rather smaller and shorter. There is an inner, somewhat glossy cuticle of very pale buff, covered with a very thin dull outer layer of a slightly darker shade, worn off in front of the aperture. The specimens from Kahana are similar. The original figure is copied.

39. A. DECORTICATA Gulick. Pl. 33, figs. 4, 5, 6, 7.

"Shell ovate-conic, dextral, lightly striated with lines of growth; chestnut, blackish towards the lip. Whorls 6 to 6½, a little convex, the first 3 polished; suture simple, pale. Aperture weak dirty-blue inside. Peristome thin, blackish within, scarcely thickened; columellar fold thin. Length 16, diam. 8.5 mm." (*Gulick*).

Oahu, western part of the main range: Kawailoa, type locality; Helemano, Opaiula, Waimea, Waialei, Kahuku and Kahana (Gulick). Under dead leaves in the forest.

Amastra decorticata Gk. in GULICK and SMITH, P. Z. S., 1873, p. 84, pl. 10, f. 14.—*Achatinella d.*, PFR., Monogr., viii, 240.—*Achatinella d.*, THWING, Orig. Descr. Achat., p. 149.—*Achatinella decortica* BALDWIN, Catalogue, 1893, p. 8.—*Laminella decorticata* Gul., W. G. BINNEY, Ann. N. Y. Acad. Sci., iii, 1884, p. 98, pl. vi, f. D (teeth).

"It is allied to *A. elliptica* Gk., the metropolis of which lies to the northwest of this, and to *A. inflata* Pfr., which is found in the valleys to the east. It is always dextral" (*Gulick*).

A series of several hundred shells from all the above localities except Helemano shows this to be quite a constant species. It never has the conspicuously patched clothing of *A. inflata* and *elliptica*, though under a lens some small dull streaks may be seen on the otherwise rather glossy surface, which elsewhere shows no epidermis in the typical form. The color is reddish-chestnut of varying intensity, frequently shading into yellowish on the upper part of the last whorl, and always much darker behind the lip. The spire is frequently darker, purplish-brown. The suture is usually marked with a yellowish line, but this is often wanting. There are 2½ embryonic whorls, the last one very lightly, minutely and un-

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evenly striate. Subsequent whorls have rather coarse, very low, uneven wrinkles, the surface being rougher and much less glossy than in *A. textilis*. The outlines of the spire contract a little near the summit, but the penultimate whorl, especially when viewed from the back, bulges noticeably. The axis is generally perforated, but in some narrow shells the crevice is nearly or quite closed. In a few old individuals there is a white callous nodule on the parietal wall, which is thinly covered with a subtransparent or dirty-white film, thin at the outer edge. Specimens from Kawailoa (pl. 33, figs. 4-7) measure:

Length 16.4, diam. 9, aperture 7.2 mm.; whorls 6.
Length 15.2, diam. 8.8, aperture 7.8 mm.; whorls 5½.
Length 16, diam. 8, aperture 6 mm.; whorls 6.
Length 15, diam. 9, aperture 7.5 mm.; whorls 5¾.

Some of the shells from Kahana, at the eastern limit of distribution of the species, have a thin outer layer of *dull, reddish cuticle, almost continuous over the last two whorls* except in front of the aperture, darker as usual on the latter part of the whorl; but owing to the similarity of the outer to the inner cuticle in color (the former more of a reddish, the latter more yellowish, tone), it is quite inconspicuous unless looked for very closely. These more fully clothed shells form an approach to *A. rubicunda* which occupies the eastern end of the range, though of course *decorticata* is always shorter, and abundantly distinct specifically.

? 40. A. INFLATA (Pfeiffer). Pl. 33, figs. 1, 2, 3.

"Shell imperforate, conic-globose, rather roughly striate; whitish, covered with a black epidermis worn off in a wide band below the suture. Spire swollen, terminating in a short, acute cone. Whorls 5½, the last three very turgid, the last about as long as the spire. Aperture oblique, sinuate-oval, white within. Columellar fold subtransverse, ascending highly. Peristome unexpanded, labiate within; columellar margin callous, dilated, adnate. Length 16.5, diam. 10, aperture 8.5x5 mm." (*Pfr.*).

Oahu (Frick, in Cuming coll.); Koolauloa (Baldwin);

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Wahiawa, type loc., and Ahonui (Gulick); Kahana (C. M. Cooke); a variety at Kawailoa (Gulick).

Achatinella inflata PFR., P. Z. S., 1855, p. 203 (Feb., 1856); Monogr., iv, 549.—BALDWIN, Catalogue, 1893, p. 9.

This species is known to me by numerous specimens from Wahiawa, Ahonui and Kahana. In the Wahiawa lot (pl. 33, figs. 1-3), which I consider typical, the shape varies rather widely, as shown in the figures. The embryonic whorls are nearly smooth, being marked with fine growth-striæ only, as in *A. decorticata*. The wrinkles of the later whorls are rather coarse and irregular, and a few spiral lines cut them in occasional individuals. The color is rich chestnut with a suggestion of orange, over which there is a very thin outer layer of darker, almost chocolate-brown, more or less worn from the wrinkles and wanting below the periphery in front of the aperture. Behind the lip it is much darker, deep chocolate or blackish. Often a peripheral darker belt may be seen. The denuded subsutural belt mentioned by Pfeiffer is seen in some dead shells of the Wahiawa lot, and in a few living ones. Under the colored cuticle the shell-substance is fleshy-whitish in the last whorl, but generally darker above it, so that the spire is purplish-brown. Immature shells are very ventricose and have a rather sharp peripheral angle which persists up to the end of the fifth whorl. *The last two whorls are much swollen below the suture*, or rarely this swelling is belated, appearing as late as the last half of the last whorl. Nearly all the shells are imperforate when mature, but the young may remain perforate up to about 10 mm. long, 4½ to 5 whorls. Specimens measure:

Length 18, diam. 10, aperture 8 mm.; whorls 6½.
Length 16.2, diam. 9.9, aperture 8 mm.; whorls 6.
Length 17, diam. 9.2, aperture 7.9 mm.
Length 15, diam. 9.9, aperture 8.3 mm.
Length 16.8, diam. 9, aperture 8 mm.

In Dr. Cooke's series from Kahana, on the north side of the range, the inflation of the later whorls is minimized, the sculpture less rough, and the color generally somewhat lighter. None of the shells are so inflated as the more obese forms from Wahiawa.

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Ahonui shells are deficient in the dull over-layer, which is very thin, and therefore not dark enough to contrast strongly with the denuded surface in front of the aperture.

A small series from Kawailoa, in the Gulick collection, A. N. S. P., is intermediate between *inflata* and *decorticata*. The rough sculpture and rather dull surface resembles *inflata*, but the dull, "bloom"-like layer is extremely thin, remaining only in a few shreds, and there is no contrast between the area in front of the aperture and that above the periphery. In these respects the shells resemble *decorticata*. It would not be amiss to refer these Kawailoa shells to *decorticata*, which is more widely distributed westward than *inflata*.

41. A. RUBIDA Gulick. Pl. 33, fig. 9.

Shell dextral, long-ovate, striated with growth-lines, dilute reddish-chestnut (rarely covered with a blackish epidermis); whorls 6, a little convex, the first two smooth, brown; suture simple. Aperture small, somewhat purple inside. Peristome thin; columellar fold very thin. Length 18, diam. 9 mm." (*Gulick* and *Smith*).

Oahu: Kahuku, at the northwest terminus of the main range, on the ground in the forest (Gulick).

Amastra rubida Gul., GULICK and SMITH, P. Z. S., 1873, p. 84, pl. 10, f. 12.

"It is allied to *Am. elliptica* Gk., but differs in being more elongate in form, thicker in structure, and for the most part destitute of epidermis. It is always dextral" (*Gulick*). Mr. Gulick's figure is copied.

The senior author writes as follows, having before him a series of 9 shells in the Gulick collection: "This species makes a close approach to *rubens* in varieties having a reddish-brown middle layer, but the periostracum is not so thick and persistent. The shell is, in fact, not covered by a periostracum except along the suture, and is more uniformly of a pinkish tone, and the aperture in most shells is pink or purple inside. The affinities with *decorticata* have been noted by Gulick, but the thick opaque shell and transient periostracum appear to place it in the *tristis* series. A set of shells consid-

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ered by Gulick to be passage forms into *decorticata* are five in number, and of these one is a true *decorticata* with entire periostracum and acute apex; the four others have the typical colors and periostracum of this species, combined with a blunter apex, shorter, stouter spires and lighter-colored apertures which may be considered as belonging to such hybrids as could be called *rubida-elliptica*. It appears to me to be therefore an *elliptica* form derived from *elliptica*."

42. A. ELLIPTICA Gulick. Pl. 34, figs. 17 to 23.

"Shell dextral, ovate, hardly shining, lightly striated with growth-lines. Whorls 5½, convex, the first 4½ brownish-corneous, and the last whorl paler, clothed with a dark olivaceous epidermis which is partly worn from the front of the last whorl. Spire somewhat turrite, suture simple. Aperture white, rose-tinted in front (sometimes white); peristome thin, very slightly thickened within. Columella arcuate, the lip-ends joined by a thin callus, provided with a compressed subbasal tooth. Length 15, diam. 8.5 mm." (*Gulick*).

Oahu: Waialei, type loc.; also in Kahuku and Hanula, and rarely in Kawailoa, on the ground in the forest (Gulick).

Amastra elliptica Gk., in GULICK and SMITH, P. Z. S., 1873, p. 83, pl. 10, f. 15.—SYKES, Fauna Hawaiiensis, 1900, p. 336.

"It is allied to *A. rubens* Gld. and *A. decorticata* Gk., but it is thinner, smaller, and darker in color than the former, and it has a more convex spire than the latter" (*Gul.*).

A. elliptica differs from *decorticata* and its allies by the strong development of the outer layer of epidermis. On the front of the last whorl it is light olive-brown with many unequal blackish streaks; on the back the streaks coalesce into a more or less continuous black area on the last fourth of the last whorl. The under layer of cuticle, exposed in front of the aperture, is pale yellow. Dead shells which have lost all of the cuticle are reddish on the spire, the last whorl white, or in 3 out of 40 from Waialei the last whorl is white above, reddish below the periphery. One of these denuded shells is drawn in pl. 34, fig. 22. Normal shells of the same lot are shown in figures 20, 21, 23.

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The embryonic shell has some faint growth-lines only, thereby differing from *A. rubens*. The young are acutely angular up to nearly 10 mm. long, as in *decorticata*, etc. The outlines of the spire are usually convex, and the summit is obtuse. The columella and basal curve of the peristome are frequently roseate. Waialei shells measure:

Length 15, diam. 8.5, aperture 7.3 mm.; whorls 5.

Length 13.4, diam. 8.9, aperture 7.2 mm.; whorls 5.

Length 15, diam. 9, aperture 7.3 mm.

Shells from Kawailoa have a blackish, more deciduous outer cuticle, and the shell beneath is pinkish or bicolored. The shells from Hanula and those from Kahuku are often paler than usual in the type locality. Three from Kahuku figured measure:

Length 16.3, diam. 9, aperture 7.4 mm.; whorls 5⅓.

Length 14.6, diam. 9, aperture 8.2 mm.; whorls 5.

Length 15, diam. 8, aperture 7.5 mm.; whorls 5⅓.

An average shell and two extremes of shape from Kahuku are figured, pl. 34, figs. 17 to 19.

Mr. Sykes remarks that two specimens collected by Mr. Perkins on Waianae Mts. may belong to a large, incrassate variety. I think that they will prove specifically different.

43. A. TRISTIS (Férussac). Pl. 32, figs. 1 to 7, 10, 13.

The shell is imperforate or rimate, oblong-conic, rather solid, ground-color of first 2 or 3 whorls blackish-purple, fading then to red-brown with a pale sutural margin, and finally diluted to light red-brown or nearly white on the last whorl; the last 2 or 3 whorls having a thin dark brown or blackish cuticle which is deciduous, remaining in angular shreds and patches, generally lost over an area in front of the aperture. Spire a little convexly conic, acute. Whorls 5½ to 5¾, nearly flat, the first nearly smooth, the next having regular radial ripples, following whorl with fine growth-striæ only. The last two whorls are marked with rather coarse wrinkles along the lines of growth, and some fine spiral striæ; and on the last whorl there are usually several unevenly-spaced spiral grooves. The aperture is ovate, slightly ob-

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lique, white inside. Peristome has a rather strong rib within. Columella short, rather widely dilated, bearing a strong spiral lamella. Parietal callus thin and transparent. The axis is slender and sinuous, widening upward in each whorl. The superposed lamella penetrates a little less than one whorl.

Length 18, diam. 11, length of aperture 9 mm. Palolo.

Length 18, diam. 10.5, length of aperture 8.5 mm. Palolo.

Length 16.5, diam. 10.2, length of aperture 8.5 mm. Palolo.

Oahu, valleys of the southeastern slope of the main range: Keawaawa, Makiki, Waialae, Palolo, Nuuanu (Gulick); Kalihi (Oleson coll.); Niu and Aeia (Cooke).

Helix tristis FÉR. (Prodrome, p. 60, undescribed), Voyage autour du Monde de l'Uranie et la Physicienne, Zoologie, p. 482, pl. 68, f. 6, 7 (1824).—*Bulimus tristis* PFR., Symbolæ, ii, p. 52.—*Achatinella tristis* PFR., P. Z. S., 1845, p. 89; Monogr., ii, p. 240; iii, 456; iv, 444; vi, 177; Conchyl. Cab., p. 286, pl. 67, f. 10, 11.—REEVE, Conch. Icon., vi, pl. 5, f. 37 (1850).—THWING, Orig. Descriptions, p. 143, pl. 3, f. 13.—*Amastra tristis* PEASE, P. Z. S., 1869, p. 649.—BALDWIN, Catalogue, p. 10.—*Achatinella fuliginosa* GOULD, Proc. Bost. Soc. N. H., ii, 1845, p. 28.

The specimens from Keawaawa, collected by Gulick, are all dead shells.

The outer chocolate or blackish cuticle is unusually persistent in one lot from the lateral ridge of Nuuanu (no. 530 Cooke coll.), and in those from Tantalus (pl. 32, figs. 6, 7). A similar black form occurred at Aiea, far to the west and widely separated from other known colonies, the nearest being in Kalihi.

One of the lots from Niu consists of dwarfed abnormally shortened shells (pl. 32, fig. 10), the last whorl more or less angular in front, the spire somewhat telescoped into the last whorl in part of the shells. One specimen has several spiral grooves cutting the growth-wrinkles on the last whorl, as in *A. undata*.

In Nuuanu shells the cuticle may be either black and in shreds, or nearly continuous and of a rich chestnut color (fig. 5). The size of these chestnut shells varies widely, length from 15 to 19 mm. Figures 1 to 4 are from Palolo shells.

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The shells from other places mentioned show little or no local differences in the series examined.

Férussac's original description (given in full below) is very poor, and the species would hardly have been recognized except for his figures. "Testa dextrorsa, ovato-inflata, vertice acuminato, striatila; epidermide bruneo-fugaci; anfractibus 5, ultimo fere carinato, suturis non distinctis; apertura semilunata; peristomate intus incrassato, fere dilatato; columella alba, depressa, costa munita; rima umbilicali vix distincta. Elle habite les iles Sandwich" (*Férussac*).

A. fuliginosa Gld. was based upon specimens with a light ground, which sometimes has a faint greenish tint, such as fig. 2. Occurring with the brown and intermediate shells at most, if not all, localities, it has apparently little claim to be considered a distinct species or race. Messrs. Baldwin, Sykes and Thwing also hold this view.

Embryonic shell.—The first half-whorl is smooth with steep sides, the suture at first descending rapidly. Fine, slightly arcuate striæ then appear. On the first half of the second whorl the striæ are a little coarser, afterward becoming so fine as to be hardly perceptible. The latter part of the last whorl has a few white spots on the reddish-brown ground, and the acute peripheral keel is white. There are 2½ whorls in all. The columellar fold is moderately developed, and the umbilical crevice very minute (pl. 32, fig. 13; length 4.4 mm.). The color is almost always purple-black, but rarely shells with a pale luteous embryo are found, as at Waialae (188 Cooke coll.), the first neanic whorl being sparsely maculate with opaque white. This variegation of the spire is unique in shells of this group of Amastræ, and with the incised spiral lines of the adult stage, it indicates relationship with *Metamastra*. *A. badia* in *Metamastra* has similar embryonic sculpture.

44. A. PORCUS n. sp. Pl. 38, fig. 3.

The shell is imperforate, *globose*-conic, *thin*, light brown throughout. The embryonic shell of 2½ whorls is conic, the first whorl convex, the rest nearly flat; surface smooth but not glossy, under a strong lens showing weak, very fine stria-

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tion. The post-embryonic whorls are more convex, roughly and irregularly sculptured with growth-wrinkles, which become quite coarse on the back of the globose last whorl. Aperture is slightly oblique, with a very thin white lining. Lip sharp and thin. Columellar lamella small, thin, white and quite oblique. Length 13, diam. 9.1, aperture 7.8 mm.; 5⅓ whorls.

Oahu: Mokuleia, Waianae mountains (Irwin Spalding).

A thin shell of unusually swollen shape. In contour it is not unlike some of the small, subglobose individuals of *A. tristis*, such as occur in Moanalua, but it differs by lacking a dark deciduous outer layer of cuticle and in the sculpture of the embryonic whorls, so that the relationship cannot be thought close. Its relationships are not clear to us. No other described Oahuan shell resembles it. The type, to be deposited in the Bishop Museum, is not fully adult.

Section PARAMASTRA Hyatt & Pilsbry.

These are pyramidal or more or less *turrited* forms, usually with the spire straight or concave-sided; whorls rather numerous, 6 to 8; shell often spirally banded or with many lines; cuticle often without a dark, deciduous, outer layer; embryo very finely striate vertically; colors variable, often variegated, frequently resembling the *Achatinellinæ* rather than the usual pattern of Amastra, probably in consequence of an adaptation to arboreal life in some forms.

Type *A. spirizona*.

The distinction between these shells and the *rubens* group is not always clear, as there seem to be some intermediate species. The group is confined to Oahu. It is much more fully developed in the Waianae Range (seven species), whence two species have migrated to the Main Range, there to give rise to two species special to the eastern range, *A. porphyrostoma* and *A. turritella*; both of these are still connected with the parent forms (*porphyrea* and *spirizona nigrolabris*) by more or less intermediate shells.

The shells of this group have a tendency to develop a second columellar fold above the usual lamella, as in the Lanaian

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biplicata group. This fold is probably homoplastic, not homologic, in the two groups; for the *biplicatæ* show characters of the cuticle of the typical group of *Amastra*, with which they are closely connected by a chain of annectant forms.

One of us (Hyatt) considered *A. turritella* "the probable ancestor of the entire group" *Paramastra*. The other author (Pilsbry) views the same species as one of the latest derivatives—a terminal twig of the *spirizona-nigrolabris* branch.

Key to Species of Paramastra.

a. Slender forms, the diameter usually less than half the length.

b. Apex rather large, bulbous; chestnut to buff, suture paler. *A. turritella*, no. 47.

*b*¹. Apex small, pointed.

c. Small, slender shells, with little dull cuticle or none.

d. Glossy, thin; white, yellowish or brown, often variegated with spiral lines; 17x 7.5 mm.

A. micans, no. 45; *A. frosti*, no. 45*a*.

*d*¹. Very slender, thick, whitish with brown apex and pinkish base; 17x6.5 mm.

A. tenuispira, no. 46.

*c*¹. Stouter shells, with a thin dull outer cuticle.

d. Spire convexly conic; 18.5x9 mm.

A. cylindrica, no. 52.

*d*¹. Spire straight; length 17, diam. 8 to 8.8 mm. *A. variegata*, no. 53.

*a*¹. Stout, pyramidal shells, the diam. half the length or more.

b. Spire concavely turrite, diam. half the length.

A. t. aeia, no. 47*a*.

*b*¹. Spire straightly conic, stouter.

A. t. waiawa, no. 47*b*.

b. Diam. decidedly more than half the length.

c. Dark brown with a yellow sutural band; 21x 11.5 mm. *A. spirizona*, no. 48.

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c^1. Base brown, light above, stouter.
A. s. nigrolabris, no. 48*a*.

c^2. Shell whitish and rusty-brown.
A. s. chlorotica, no. 48*c*.

c^3. Shell reddish-brown with pale striæ; no dark outer cuticle. *A. porphyrea*, no. 50.

c^4. Whitish, yellow or brown under a fragmentary cuticle.

d. Parietal callus purplish.
A. porphyrostoma, no. 51.

d^1. Not so colored. *A. intermedia*, no. 49.

45. A. MICANS (Pfeiffer). Pl. 37, figs. 5, 6, 7.

Shell subperforate, dextral, turrited, rather solid; white, under a buff epidermis having a varnish-like luster. Spire regularly tapering, the apex rather acute; suture somewhat crenated. Whorls 7, a little convex, the last scarcely more than one-third the length, rotund. Columellar lamella rather small, oblique. Aperture slightly oblique, suboval; peristome simple, unexpanded, the columellar margin a little dilated, somewhat free. Length 16, diam. 7⅔ mm (*Pfr.*).

Sandwich Islands (Frick, in Cuming coll.). Oahu (Baldwin, Huchison); back of Leilehua, Waianae valley (C. Montague Cooke).

Achatinella micans PFR., P. Z. S., 1859, p. 31; Monogr., vi, 179.—*Amastra micans* PSE., P. Z. S., 1869, p. 650.—HARTMAN, Proc. A. N. S. Phila., 1888, p. 47, pl. 1, f. 10.—BALDWIN, Catalogue, p. 9.—*A.* (*Laminella*) *micans* SYKES, Fauna Hawaiiensis, p. 350.—*Amastra frosti* Ancey, var. *unicolor* ANCEY, Proc. Malac. Soc. London, iii, p. 269, pl. 12, f. 11, July, 1899.

Hartmans figure was from a specimen apparently identical with "*A. frosti unicolor*," some of which have exactly the dimensions of *micans*, and seem to be entirely identical. Since Sykes, who had access to the type specimens of both, kept them apart, and even in different subgenera, I give here the descriptions of both. *A. frosti*, if my view is correct, should be ranked as a color-variety of *micans*.

A. frosti unicolor Ancey. Pl. 37, fig. 4. "Shell shaped

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like the type, but uniform straw-yellow, entirely destitute of brown bands'' (*Ancey*).

Waianae mountains (Baldwin and others).

Mr. Ancey's figure is copied in fig. 4. The tint is variable. Figures 5, 6 represent brown or yellowish-brown shells. Others, about half of the lot seen, are whitish with a very faint greenish-yellow tint on the last whorl or two, the upper part of the spire being brown-tinted, and the embryonic whorls purplish-brown or dull blue (fig. 7). Whether these color-forms occur in one and the same colony we do not know; nor are we advised whether the banded *frosti* is found with them or not. Their possibly racial status depends upon the segregation or association of the forms. The surface in all is glossy, and generally they retain traces of a thin brown or blackish outer cuticle, of which fragments remain in spots on a band below the suture, and sometimes scattered on the last whorl, more being retained in half-grown than in adult individuals. As a rule, the columellar lamella is rather small and the face of the columella above it is smooth; but in one shell there is a second well-marked, more oblique fold above the normal one, such as occurs occasionally in *A. turritella*, *A. nigrolabris*, and others of this group of species. The shape is similarly variable in all the color forms, as shown in the figures and measurements. Axis rimate. In a few shells of typical coloring there is a weak carina on the last whorl.

Length 15.5, diam. 7.2, aperture 6 mm.; 7 whorls.

Length 15, diam. 8, aperture 6.1 mm.; 6½ whorls.

Length 17.2, diam. 7.5, aperture 6.1 mm.; 7½ whorls.

Length 16.5, diam. 8, aperture 6.3 mm.

The above notes are from a series of 48 shells in coll. C. M. Cooke, from back of Leilehua, Waianae range, 11 in coll. Boston Society N. H., and 3 in coll. A. N. S. P.

45*a*. A. FROSTI Ancey. Pl. 37, figs. 2, 3.

''Shell minutely and very narrowly rimate, conoid-turrited, glossy, impressed with minute, pliciform, more or less obsolete growth-striæ; straw-buff or yellowish-tawny, encircled with many variously placed narrow, often confluent, bay, spiral

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lines. Spire long, conoid-tapering, acute. Whorls 8, the first uniformly colored, flattened, the rest a little convex, suture impressed, last whorl larger, somewhat tapering, rotund-oval. Aperture distinctly oblique, not very large, irregularly oval, tapering above. Columella moderately thickened, whitish, armed with an acute, prominent, oblique fold remote from the base. Peristome simple, acute, the margins joined by a glossy callus in adults. Length 20, diam. 8.5, alt. apert. 7 mm." (*Ancey*).

Oahu: district of Waianae (Baldwin); near Waianae and Waialua (U. S. Nat. Mus.).

Amastra frosti ANCEY, Mémoires de la Société Zoologique de France, v, 1892, p. 719.—SYKES, P. Malac. Soc. Lond., iii, p. 275, pl. 13, f. 12 (co-type).—*Achatinella frosti* THWING, Orig. Descriptions, etc., p. 161, pl. 3, f. 18 (good).

Smaller than *A. cylindrica*, with straight lateral outlines and a more glossy surface. Mr. Sykes's figure of one of Ancey's co-types is copied, fig. 2. A lot before us from C. M. Cooke coll., consists of shells smaller than the dimensions assigned by Ancey. Length 16.7, diam. 7.9, aperture 6.2 mm., whorls 7½. The apex is clear whitish with weak, fine, longitudinal striæ; bands begin on the third whorl. The ground-color is whitish, the bands chestnut. There is no outer layer of deciduous cuticle. One of these shells is figured, fig. 3.

46. A. TENUISPIRA Baldwin. Pl. 37, fig. 1.

"Shell dextral, imperforate, solid, acuminately turreted, spire conical, apex subacute; surface lusterless, covered with somewhat rude, irregular incremental striæ; the embryonic whorls very finely, radiately sulcated. Color light brown, upper whorls darker; covered with an earthy-brown, fugacious epidermis. Whorls 7, somewhat convex, in some examples slightly margined above; suture well impressed. Aperture oval, oblique, rather small, light brown within; peristome simple, acute, extremities united with a thin callosity; columella sub-biplicate, light brown, tortuous, abruptly terminating in an oblique, dentiform plait. Length 17, diam. 6½ mm." (*Baldwin*).

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Oahu: Mt. Kaala, Waianae range, very local (Baldwin).

Amastra tenuispira BALDW., Proc. A. N. S. Phila., 1895, p. 232, pl. 11, f. 51.

Figured from the types. This species very closely resembles the whitish race of *A. micans,* but the surface is rougher and the color of the aperture differs. It is also a little more slender, the whorls are slightly more convex, and the axis imperforate.

The shell is very thick. Last whorl white or pale buff, more or less pink-tinted towards the termination; spire gray or brownish, the embryonic whorls dark brown. There are small spots and shreds of a brown outer cuticle on the last whorl. There is sometimes an impressed line below the suture on the last whorls. The whole interior is pink-tinted, or sometimes nearly white, and there is a low, more oblique fold above the usual columellar plait, more prominent in some specimens than in others.

Length 15.2, diam. 6.5, aperture 6 mm.; 6½ whorls.

Length 16, diam. 6.9, aperture 6 mm.; 6¾ whorls.

47. A. TURRITELLA (Férussac). Pl. 35, figs. 1 to 4.

"Shell dextral, elongate, conic, striatulate; whorls 6; apex obtuse; suture distinct, not duplicate; aperture strongly oblong; peristome thickened within; columella perforate, nearly straight, provided with a distinct rib. Sandwich Is." (*Fér.*).

Oahu, southern valleys of eastern half of the main range: Waialae, Palolo, Matiti, Nuuanu, Moanalua, Halawa, Aeia, a variety at Waiawa.

Helix turritella Fér. (Prodr., Tabl. Syst. no. 434, nude name), Voy. autour du Monde de l'Uranie et la Physicienne, Zoologie, p. 481 (1824); Hist., pl. 155, f. 13.—SOULEYET, Voy. Bonite, Moll., pl. 29, f. 7, 8.—*Achatinella t.*, REEVE, Conch. Icon., vi, pl. 5, f. 34, 41.—PFR., Monogr., ii, 233; Conchyl. Cab., p. 285, pl. 67, f. 18, 19.—NEWCOMB, Ann. Lyc. N. H. of N. Y., vi, p. 307 (animal).—*Amastra t.*, PEASE, P. Z. S., 1869, p. 650.—SYKES, Fauna Hawaiiensis, Moll., p. 346.—GULICK, Evolution, Racial and Habitudinal, p. 39, pl. 1, f. 17 (Palolo). —*Achatina oahuensis* GREEN, Contrib. Maclurian Lyc. to the

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Arts and Sciences, i, 1827, p. 49, pl. 4, f. 5.—*A. inornata* MIGHELS, Proc. Bost. Soc. N. H., ii, 1845, p. 21.

"Animal short, only half as long as the shell, of a dark slate-color on the sides; superior portion and tentacles black; under surface of foot light gray; mantle dark brown" (*Newcomb*).

Nuuanu valley may be taken as the type locality of this very distinct species. The typical form, as figured by Férussac, is chestnut-brown. The embryonic shell is often somewhat darker, purplish, but it may be whitish-corneous or flesh-colored. The apex is rather blunt and rounded, second embryonic whorl very finely striated vertically, the striæ interrupted by some weak spirals. The adult stage has fine striæ over low growth-wrinkles. The subsutural region is generally paler-colored. Aperture blue-white or with a faint pink tint within. Outer lip acute; columellar plica not very strong, and often there is a low, oblique fold above it. Axis generally perforate. Length 20, diam. 8.7, aperture 7.5 mm.; 7 whorls; fig. 2 (Nuuanu valley, C. M. Cooke). Other color-forms from Nuuanu valley are as follows:

2. Fig. 1. Chocolate-brown, with or without a yellow subsutural line. Length 23, diam. 9, aperture 8 mm.; 8 whorls.

3. Fig. 3. Yellow, shading into chestnut towards the end of the last whorl, apex generally dark; a white subsutural line sometimes present.

4. Pale, corneous-buff, the apex generally pale, last whorl showing traces of a thin, pale brownish cuticle (fig. 4, Matiti).

Two small specimens from Waialae resemble forms 1 and 3. A series from Palolo contains forms 1 and 4. In Moanalua Cooke found form 2 and an intermediate between 3 and 4. In Halawa we have form 3 and intermediate between 3 and 4. In Matiti (Gulick, = Makiki?) forms 2, 3, 4 (fig. 4).

The synonymous *A. oahuensis* had the typical coloring of *turritella*. *A. inornata* Mighels had forms 1 and 4, and may have been from Palolo.

Dr. C. Montague Cooke informs us that *A. turritella* is found in grass, and on both aerial roots and leaves of the Ieie (*Freycinetia*). When on these roots the shell is covered with a

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short green growth like the green coating of the roots. Those on grass in a dry place were perfectly green. All the shells we have studied have been cleaned.

47*a*. Var. *aiea*, n. var. Pl. 35, figs. 5, 9. The shell has very convex whorls and concave lateral outlines, the last whorl more inflated than in *turritella*. Yellow with a brown summit (fig. 5), or dark purple-brown with a light subsutural band (fig. 9).

Fig. 5. Length 16, diam. 8 mm.; 6½ whorls.

Fig. 9. Length 18.2, diam. 9.3 mm.; 6⅔ whorls.

Aeia, a short valley dividing the ridge west of Halawa. Co-types no. 1014 and 1045 Cooke coll.; no. 104691 A. N. S. P.

47*b*. Var. *waiawa* n. var., pl. 35, figs. 7, 8. Shell decidedly wider, the outlines of the spire nearly straight.

Length 16.3, diam. 9.5, aperture 7.2 mm.; whorls 6½.

Length 16, diam. 9, aperture 6.7 mm.; whorls 6½.

Length 19, diam. 9.3, aperture 7.2 mm.; whorls 7.

The colors are: yellow or whitish above, chocolate below the periphery, summit dark. Chocolate with a light subsutural band. Yellow, shading towards chestnut behind the lip, summit flesh-colored or light. These occur in the proportions of 2, 3 and 10 specimens respectively.

Waiawa. Gulick coll., no. 92231 A. N. S. P.

It will be noted that these shells parallel in color-patterns the forms *spirizona, nigrolabris* and *chlorotica*. The *nigrolabris* pattern has not been seen in other lots of *turritella*, but the dark and pale examples have the color of *turritella* forms 2 and 3.

In shape, color and geographic position this race stands between *nigrolabris* and *turritella*. It is probably a remnant of the transitional forms which terminated in the evolution of *turritella*.

48. A. SPIRIZONA (Férussac). Pl. 35, figs. 16, 17, 18.

The shell is ovate-pyramidal, rather solid, chestnut or dark *purplish-brown, with a sharply defined buff band below the suture* on the last three or four whorls, the summit dull purple or purple-black. *Spire straightly conic*, rather acute. Em-

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bryonic whorls slightly convex and very finely striate. Later whorls lightly marked with growth-wrinkles. The cuticle is thin and polished, occasionally worn in front of the aperture, and often some trace of a very thin lusterless outer coat remains in patches on the last whorl, hardly noticeable except by aid of a lens. Whorls moderately convex. Aperture oblique, white inside, the outer lip thin, with a dark border within. Columellar plait small. Columellar margin short but rather broadly reflexed, generally leaving an umbilical crevice. Length 21, diam. 11.5, aperture 9.7 mm.; whorls 7.

Oahu, western range: Waianae, Lihue, almost exclusively on the ground (Gulick); below Kaala on the lee side (Perkins). Lives on low bushes and ferns.

Helix spirizona FÉR. (Prodrome, Tab. Syst., p. 56, nude name), Voyage autour du Monde de l'Uranie et la Physicienne, Zoologie, p. 480; Histoire, pl. 155, f. 14, 15.—*Helicteres spirizona* BECK, Index, p. 51 (1837).—*Achatinella spirizona* Fér., PFR., Monographia, ii, 235; iii, 458; iv, 548; vi, 179; viii, 238.—NEWCOMB, Ann. Lyc. N. H., vi, p. 307.—REEVE, Conch. Icon., vi, pl. 2, f. 16.—*Amastra spirizona* Fér., SYKES, Fauna Hawaiiensis, p. 344, with var. *nigrolabris* and *rudis*.—*Achatinella acuta* SWAINSON, Quart. Journ. Sci. Lit. Arts, i, 1828, p. 84; Zool. Illustr., ser. 2, iii, pl. 99, f. 3.—*Achatinella baetica* Mighels, in Cuming coll., undescribed.

According to Newcomb, the animal is "thickly studded with very black granulations with the interstices of a light slate; mantle of a yellowish-white."

This well-known shell is easily recognized by its rich, dark coloration. Férussac's excellent original figure is copied in our fig. 16. The original description follows: "Shell dextral, conic, acute, striate, of a brown color encircled with a white band at the suture, the apex black-brown. Whorls 6, gradually increasing; suture not duplicate. Aperture coarctate, oval; peristome thick within, violaceous. Columella nearly straight, provided with a distinct rib; an umbilical crevice. It probably inhabits the Sandwich Islands."

The original locality is not known with certainty. The *Uranie* Achatinellidæ, with two exceptions, were from Nuu-

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anu and Manoa valleys, back of Honolulu; where *luteola* came from is not known; and *spirizona* is the only species known to be from any other district. Since exactly typical shells occur in the Waianae mountains, especially up Waianae valley on Mt. Kaala, this valley may be considered the type locality.

There is some variation in proportions, chiefly between the following extremes:

Fig. 18. Length 21.3, diam. 10.3, aperture 9 mm.; 7 whorls (Waianae).

Fig. 17. Length 19, diam. 12, aperture 9.5 mm.; 6½ whorls (Lihue).

Achatinella acuta Swainson was based upon specimens from the northern range having the *spirizona* coloring, such as occur mingled with *nigrolabris* in Kawailoa valley, and doubtless interbreeding with *nigrolabris*, which is the dominant form; as usual in such Mendelian hybrid races, the mutant dominates. Swainson's type was a shell in which there is a deep sinus below the columellar lamella, such as we have figured in pl. 40, fig. 16, from Kawailoa. This feature is quite variable, both in *spirizona* and *nigrolabris*. The basal lip is not quite so deeply arcuate as in *spirizona*. Properly speaking, the name *A. acuta* is not a synonym of *spirizona*, but belongs to the *spirizona* × *nigrolabris* hybrid race; see below.

It may be mentioned here that all of Swainson's Achatinellas were collected by Lord Byron, an account of whose voyage has been published (Voyage of H. M. S. Blonde to the Sandwich Islands in the years 1824-1825. London, 1826). The only Oahuan port visited by the Blonde was Honolulu. All of the *Achatinellidæ* brought home were strung on a necklace, which was evidently made in Kawailoa valley, the species and color-forms being all such as occur in that neighborhood, none of them being from the Waianae mountains, or from eastern Oahu. Dr. Newcomb has already noted this fact.

48*a*. *A. s. nigrolabris* Smith. Pl. 35, figs. 10 to 15.

"Shell dextral, globose-conic, perforate (the perforation sometimes covered by callus), little shining, longitudinally rugose (hardly spirally) striate; deep black-brown, encircled

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below the suture by a broad pale dirty flesh-colored zone. Whorls 6½, the first 3½ nearly flat, blackish, the rest convex; suture hardly margined. Aperture white; peristome with a thin blackish-purple edge, lightly bordered within; columella roseate, provided with a laminiform basal fold (and sometimes one or two tubercles). Length 20, diam. 12 mm."

Oahu, western part of the northeastern range: Wahiawa, type loc.; also found in all the valleys from Kalaikoa to Waimea, sometimes on the ground but more frequently on trees (Gulick). Type in British Museum.

Amastra nigrolabris Sm., GULICK and SMITH, P. Z. S., 1873, p. 85, pl. 10, f. 9.—PFR., Monogr., viii, p. 238.—*Achatinella nigrolabris* THWING, Orig. Descriptions, p. 148, pl. 3, f. 15 (uncharacteristic).—*Laminella nigrolabris* Smith, W. G. BINNEY, Ann. N. Y. Acad. Sci., iii, 1884, p. 98 "lingual dentition as in *mastersi*."

Typically the last whorl of this snail is light-colored from suture to, or nearly to, the periphery, 2 or 3 preceding whorls being light with a dark band above the suture, and the outlines of the spire are a little concave (figs. 14, 15, Wahiawa); but in most of the lots before us there are also specimens in which the light color is confined to a narrow band below the suture, generally shading into the dark basal color, but sometimes as sharply defined as in *spirizona*. Such shells are referable to Swainson's *acuta*. They are figured in pl. 35. fig. 10, and pl. 40, fig. 16 (Kawailoa), and pl. 35, fig. 12 (Waimea). There are also transitional specimens, as Mr. Sykes has pointed out, both in color and shape, between *spirizona* and *nigrolabris*.

The fact seems to be that a formerly widespread stock has been diversely modified on the two ranges. On the northern range the herd is composite, consisting of a mixture of *spirizona* forms (which might be called *acuta* Swains. if they need a name), with a broad-banded mutation peculiar to that range (typical *nigrolabris*), the latter predominating. This color-change is apparently coincident with a change in progress from terrestrial to arboreal habits, *nigrolabris* living on bushes, *spirizona* generally on the ground.

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Wahiawa topotypes of *nigrolabris* from the Gulick collection measure:

Fig. 14. Length 18.7, diam. 11.8, aperture 9 mm.

Fig. 15. Length 20.5, diam. 11, aperture 8.5 mm.

In Kahana valley (C. M. Cooke coll.) the shells are rather small. Some have typical *spirizona* pattern, others transitional, others typical *nigrolabris* pattern (pl. 35, figs. 11, 13). Specimens measure:

Length 16, diam. 10 mm.

Fig. 11. Length 19.5, diam. 10.8 mm.; 6½ whorls.

Fig. 13. Length 19, diam. 11 mm.

Length 18.3, diam. 9.5 mm.

Specimens have been examined from Waimea, Kawailoa (fig. 10), Helemano, Wahiawa, Opaiula, Ahonui, and Kalaikoa on the southern slope of the range, collected by Gulick, and from Kahana on the northern slope, collected by C. M. Cooke, Jr.

A few specimens from Kawailoa, Helemano and Wahiawa have the base of the shell of a rusty red-brown color, in place of the usual dark purple-brown, the upper surface being light buff. These forms resemble *A. s. rudis* save that the light band extends to the periphery.

48*b*. *A. s. rudis* (Pfeiffer). Pl. 33, fig. 10.

Shell subimperforate, ovate-turrite, solid, rudely striate, fulvous-brown; spire elevated-conic, the apex rather acute, [illegible]e simple, very lightly crenulate. Whorls 7½, moderately [illegible]x, the last scarcely forming two-fifths the total length, [illegible]. Aperture oblique, sinuate-oval; columellar fold me[illegible]aminiform, subtransverse; peristome simple, acute, the [illegible]lar margin dilated, reflexed, subadnate. Length 21, [illegible].5, aperture 9 mm. long, 5 wide (*Pfr.*).

Var. [illegible] Chestnut, with buff median and basal bands, spire [illegible]s leng[illegible]hened (*Pfr.*).

[illegible]andwich Is. (Frick).

[illegible]*chatinella rudis* Pfr., P. Z. S., 1855, p. 5, pl. 30, f. 17; [illegible]ogr., iv, 549.

Pfeiffer's type figure, copied in fig. 10, represents a form

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essentially with the color pattern of *A. spirizona*. It seems to us to represent a pallid form or race of that species, or perhaps of the similar narrow-banded form of *nigrolabris*. It can hardly be "a variety of *A. intermedia* Newc.," as Dr. Newcomb claimed (Ann. Lyc., vi, 320). The var. *b* was subsequently referred to *A. albida* by Pfeiffer.

48*c*. *A. s. chlorotica* (Pfeiffer). Pl. 35, figs. 19, 20.

Shell subperforate, ovate-conic, solid, rugulose-striate, whitish, variegated in streaks with greenish epidermis; spire conic, rather acute. Whorls 6, the upper a little convex, the penultimate swollen, the last whorl about two-fifths the total length, rotund. Aperture oblique, truncate-oval, white within. Columellar fold very slight, almost none. Peristome simple, unexpanded, the columellar margin dilated, somewhat free. Length 18, diam. 10.5, aperture 8x5 mm. Oahu, Frick in Mus. Cuming (*Pfr.*).

Oahu, Main Range: Kalaikoa, Ahonui, Wahiawa (Gulick); Kahana (C. M. Cooke).

Achatinella rudis var. *b*, PFR., P. Z. S., 1855, p. 5.—*Achatinella chlorotica* PFR., P. Z. S., 1855, p. 203; Monogr., iv, p. 563, no. 4.—*A. albida* PFR., t. c., p. 203, no. 6.—THWING, Orig. Descript., etc., pp. 154, 155 (Mt. Kaala).

The shells from the localities mentioned above are referable to *A. albida*, which seems to be not separable from *chlorotica* Pfr. Typical *chlorotica* we have not seen. It appears to differ from "*rudis* var. *b*" = *albida* by lacking the tawny band or streak coloring; whether as a race or only as an individual mutation we have at present no means of knowing, though material to decide the question is probably extant in some of the great collections in the islands.

These shells are merely *A. s. nigrolabris* in which the purple-brown pigmentation is wanting, leaving the rusty-red coloring and all other features unchanged. *A. chlorotica* is the blond, *A. nigrolabris* the brunette. The series before us shows no actual intergradation, yet the relationship is so intimate that it seems proper to rank *chlorotica* as a variety of the other. Such mutations are often observed where a single

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color-factor is inhibited without otherwise changing the animal. In this case the peculiarity has been perpetuated in a race. Specimens from Kalaikoa (fig. 19) and Wahiawa (fig. 20) are figured.

Under the cuticle the shell is white below the periphery, rusty red-brown, uniform or streaked above it. Over the whole there is a light greenish-yellow cuticle, and on the last whorl there may also be a very thin, light brown, partially deciduous outer cuticle. The spire is streaked with rust-brown; the embryonic whorls yellow-corneous or light brown. The outlines of the spire are generally concave. The columella and lip have a rose tint.

Sometimes there is a rusty belt below the periphery, the latter then marked with a pale band or zone. Size and shape vary as in *A. s. nigrolabris*.

Length 18.7, diam. 11 mm.

Length 18, diam. 12 mm.

The columella is heavily calloused above the rather small plait, and it occasionally has one or two small tubercles, or a low, narrow fold above, such as occurs in some specimens of *A. s. nigrolabris*. The umbilicus may be open or closed.

Dr. Newcomb (1858) first united *A. rudis* var. *b*, *A. chlorotica* and *A. albida*. In 1893 Mr. Baldwin subordinated *rudis*, *chlorotica* and *albida* to *nigrolabris* as color-varieties; but Pfeiffer's names are prior to *nigrolabris*. It is, however, true that *nigrolabris* is the parent form, the others derivatives. Mr. Thwing records *A. chlorotica* and *A. albida* from Mt. Kaala. It is not likely that he had the form here identified as *chlorotica*. The original description of *albida* follows:

Achatinella albida Pfr. Shell perforate, ovate-turrite, thin, irregularly striate, whitish streaked with a pale fulvous epidermis. Spire conic, the apex somewhat acute, the suture very slightly crenulate. Whorls 6, the upper flat, following more convex, the last scarcely ⅖ the total length, rotund, obsoletely subangular at the periphery. Aperture a little oblique, sinuate-oval. Columellar fold median, laminiform, oblique. Peristome simple, unexpanded, the columellar margin shortly reflexed, nearly free. Length 17, diam. 9½ mm. Sandwich Is., Mr. D. Frick, Cuming coll. (*Pfr.*).

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49. A. INTERMEDIA (Newcomb). Pl. 33, fig. 8; pl. 34, figs. 6 to 12.

"Shell dextral, cylindrical; whorls 7, rounded; suture rather deep; aperture small, subovate; columella with a small flexuous plait; lip acute; striæ numerous, well developed, and longitudinal to the shell; color uniform dark brown, usually lighter at the sutures, interiorly of a bluish-white or slate color; columella bluish-white. Length fourteen-twentieths, diam. seven-twentieths of an inch" [17.5x8.75 mm.] (*Newc.*).

Oahu: Waianae (Newcomb); ridges of Nuuanu [?], and Waianae Mts. below Kaala (Perkins); Waianae and Lihue (Gulick).

Achatinella intermedia NEWC., P. Z. S., 1853, p. 135, no. 14, pl. 22, f. 13 (1854); Ann. Lyc. N. Y., vi, p. 325.—*Amastra i.*, SYKES, Fauna Hawaiiensis, p. 338.—*Amastra conicospira* SMITH, P. Z. S., 1873, p. 86, pl. 10, f. 10.

We are unable to find any characters to distinguish between some varieties of this species and of *A. porphyrea*. Specimens from Waianae are figured, pl. 34, figs. 11, 12. The first half-whorl is smooth; then slightly arcuate striæ appear; these are rather strong on the first half of the second whorl, after which they become very fine and close, and weaker towards the lower suture. The embryo seems to comprise nearly 3 whorls. It is narrower, higher and more conic than in *A. rubens*. The spire is nearly straightly conic in Waianae specimens, yet there is a slight convexity in the outlines of the lower part, while near the summit it is slightly contracted. This double curvature is more conspicuous in some of the shells from Lihue. Subsequent whorls have rather coarse, low and irregular growth-wrinkles. The first 3 or 4 whorls are of a uniform dark purple-brown color; then a yellow line appears at the suture, widening to an ill-defined band on the last whorl, and the ground-color changes to dark reddish-brown, with some paler streaks along wrinkles, and usually remains of dull, blackish streaks of a deciduous outer layer of cuticle. There is no distinctly lighter patch in front of the aperture, but some shells obscurely show darker bands in the ground-color there. The aperture is white or blue-

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white within, with a dark border in the acute lip. An axial crevice is present in some examples. Length 20, diam. 10.7 mm.; 6¾ whorls (Waianae).

In a series from Lihue (pl. 34, figs. 6 to 10) there are some shells having a reddish-brown, uniform or indistinctly banded under-color, like those from Waianae; others have a cream, pale brown-tinted or dirty-whitish ground with faint or distinct reddish bands; and all are covered with a rather thin outer cuticular layer, which is brown or olivaceous on the pale, blackish on dark individuals. The embryonic whorls are generally dark, but sometimes pale. One specimen from Waianae (Gulick coll.) is like the paler Lihue shells. These light and banded specimens approach very close to *A. cylindrica*, and there may be actual intergradation; yet, in general, *A. intermedia* is a more robust race, with straighter lateral outlines and a decidedly more conspicuous outer layer of cuticle.

Up to a length of about 12 mm. the periphery is acutely angular, and the umbilicus present as a narrow crevice. In the adult stage it is imperforate.

A shell probably from Waianae is figured, pl. 33, fig. 8, to show the coloration when the outer coat of cuticle is removed. The ground-color is cream-white, with many bright chestnut lines and bands, beginning faintly on the penult. whorl and becoming dark and wide on the base of the last whorl. Much wider at all stages of growth than *A. cylindrica*. Length 19.2, diam. 11, aperture 9.3 mm.; whorls 6½. A young shell in the same lot is 13 mm. long, of 5 whorls, and has a width of 8.9 mm. It is wholly imperforate.

Amastra conicospira Smith. Pl. 27, fig. 18; pl. 38, fig. 14. "Shell ovate-conic, dextral, striated with growth-lines; dirty-whitish, partly covered with olivaceous epidermis. Whorls 7, nearly flat, the first three or four light reddish, following two purplish-brown. Spire straightly conic. Suture simple. Aperture dirty-white. Peristome thin, brownish within, scarcely thickened; columellar fold thin. Length 20.5, diam. 10 mm. Sandwich Is." (*Smith*).

"But one specimen of this species has been received, and

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without notes concerning the station and habitat, except that it is from the Sandwich Islands" (*Smith*).

The original figure is copied, pl. 27, fig.18. In pl. 38, fig. 14, we have given an enlarged figure of the same unique type specimen, now in coll. Boston Society of Natural History. It is undoubtedly a rather turrited example of *A. intermedia*, almost exactly like some of the shells from Lihue. The internal border of the outer lip and the columella above the fold are violaceous rather than "brownish." Length 20, diam. 10.8 mm.; 6¾ whorls.

50. A. PORPHYREA (Newcomb). Pl. 33, figs. 14 to 21.

Shell rather solid, acuminately conical. Whorls 7, subcarinated above, plano-convex; suture deeply impressed. Aperture subovate, contracted below; lip thin; columella short, terminating in a twisted plait. Epidermis thin and black; striæ longitudinal and strong; color beneath epidermis of a leaden hue, with numerous transverse lines encircling the shell. Length .75, diam. .4 inch. (*Newc.*)

Oahu: Waianae (Newcomb, type loc.). Waianae and Lihue (Gulick); near Mt. Kaala (Thwing); main range at Ahonui and Wahiawa (Gulick) and Kahana (C. M. Cooke).

Achatinella porphyrea NEWC., P. Z. S., 1853, p. 136, pl. 22, f. 16; Ann. Lyc. N. H. of N. Y., vi, p. 326.—PFR., Monogr., iv, 554.—THWING, Orig. Descript., p. 156, pl. 3, f. 16.—*Achatinella grossa* PFR., P. Z. S., 1855, p. 204; Monogr., iv, p. 551.—*A. grassa* Pfr., HARTMAN, 1888.

This species may prove to be indistinguishable from *A. intermedia* Nc., which seems to be connected with *porphyrea* by intermediate forms. In two lots from Newcomb, none of the shells retain an outer coat of "thin and black" epidermis. They vary from about the size given by Newcomb to longer, less obese forms, 19x11 mm. to 22x11.5 mm. The ground-color is a dull, livid, dark red, with or without darker and lighter streaks, and sometimes having indistinct spiral lines. A subsutural narrow band is yellowish, sometimes indistinct, but more often inconspicuous. The striæ are livid whitish in some of the shells. The apical whorls are dull blackish-purple

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in five, nearly white in three shells of the lot. Two of these shells from Newcomb are figured, pl. 33, figs. 15 (Waianae) and 16. Newcomb's original figure is copied, pl. 33, fig. 17.

In a series of three shells from Waianae collected and labeled *porphyrea* by Gulick, one specimen is like the Newcomb shells, the others having a buff ground with numerous reddish lines, a pink apex, and many shreds of brown cuticle on the last two whorls, exactly as in *intermedia*, to which form these shells may perhaps be referable.

A large series from Lihue (pl. 33, figs. 18-21) labeled *A. grossa* Pfr. by Gulick, consists of rather robust shells, variously colored:

1. Last whorl or two bright yellow with a white subsutural band, early whorls flesh-colored. Cuticle very thin, not deciduous in shreds, becoming light chestnut behind the lip (fig. 20).

2. Very pale fleshy-buff, early whorls flesh-brown; last two whorls partly covered with remains of an opaque, brown or blackish cuticle (fig. 21).

3. Under color fleshy-brown, apex often purplish, cuticle opaque and dark (fig. 18).

4. Same as preceding, but there are darker spiral lines and bands on the later whorls; the coloration being like *intermedia* and *cylindrica* (fig. 19).

In these shells the spire is straightly or almost straightly conic, and the lip is thickened within. The proportions are rather variable:

Length 18.5, diam. 11.2 mm.; 6½ whorls.

Length 19, diam. 11 mm.

Length 20, diam. 11.2 mm.

Specimens referred by Gulick to *porphyrea* are also before us from the main range of Oahu—Ahonui and Wahiawa (pl. 33, fig. 14), and also from Kahana on the north side, where it was collected by C. M. Cooke. These shells have rather strongly raised, light-colored striæ on a ground of dull red and purplish, summit dull purple, blue or flesh-colored; suture generally, but not always, marked with a light line. There is no trace whatever of opaque outer cuticle. The fine filiform

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light lines on a dark ground give this form a peculiar and distinct appearance. The dimensions and proportions vary rather widely:

Length 16.8, diam. 11 mm.
Length 19.2, diam. 11 mm.
Length 17.2, diam. 10 mm.

Another lot from Kahana, Cooke coll., contains fleshy-brown shells with a partly deciduous dark brown cuticle, spirally banded and lineate shells, and one pale buff throughout. This lot is less roughly striate than the preceding, being very much like the forms from the Waianae range. The locality "Manoa" given by Hartman is evidently an error.

Achatinella grossa Pfr. is identical with *porphyrea* according to Newcomb, an opinion which later authors have approved. The description follows:

"Shell imperforate, dextral, conic-ovate, solid, somewhat roughly striate, chestnut-colored. Spire ovate-conic, the apex acute, blackish, suture pale, crenulate. Whorls 7, the upper ones flat, smooth, the following gradually becoming more convex; last whorl about two-fifths the total length. Aperture oblique, sinuate-semioval, whitish inside; columellar fold laminiform; subtriangular, nearly transverse; peristome unexpanded, acute, the margins joined by a whitish callus, right margin somewhat labiate within, columellar margin adnate. Length 23, diam. 11, aperture 10x5 mm. Sandwich Islands, Frick in Cuming coll." (*Pfr.*).

51. A. PORPHYROSTOMA Pease. Pl. 37, figs. 8, 12, 13.

"Shell dextral, imperforate, thick, long-conic, marked with fine rough striæ, covered with a very thick, brown, rough epidermis, below which there is a thin, smooth, brown one. Spire convexly conic. Whorls 6, convex, the last convex, half the total length; suture well marked. Aperture subelliptical, subangular at the base. Columella narrow, vertical; columellar fold thick, lamelliform, nearly transverse. Outer margin simple. Ground-color of the shell under the epidermis yellowish. Columella and outer lip of a purple tone; summit reddish-brown. Length 20, diam. 11 mm.

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"The peculiar color of the aperture and the rugose, very peculiar epidermis with which the animal covers its shell distinguishes this species well from its congeners" (*Pease*).

Oahu (Pease): central portion of the main range at Wahiawa (Gulick); Kahana (C. M. Cooke, Jr.).

Amastra porphyrostoma PEASE, Journal de Conchyliologie, xvii, 1869, p. 172; P. Z. S., 1869, p. 649.—*Achatinella p.*, PFR., Monogr., viii, p. 233.—HARTMAN, Proc. A. N. S. Phila., 1888, p. 48, pl. 1, f. 6.

Fig. 12 represents a specimen from the Pease collection. Those taken by Gulick in Wahiawa valley are typical. The internal border of the outer lip, the columella *and parietal callus* are of a fine though not very deep purple color. The apical whorls are brown, or sometimes purple-brown with a pale band at the top. The "rugose-brown epidermis" mentioned by Pease is foreign matter plastered on after the manner of *Pterodiscus*, etc. The real cuticle is thin, smooth, and of a light yellowish-chestnut color, the calcareous layer below being pale fleshy-yellowish. The axis is often perforate. The second embryonic whorl is very finely striate, as in *A. turritella*, etc.

The shells from Kahana valley, on the north side of the range, have but little purple color within the outer lip, and the parietal callus is of a rather dull brownish purple. The shredded cuticle is of a dull, cold, brown color (pl. 37, figs. 8, 13).

Length 20.2, diam. 12, aperture 10 mm.; whorls 6.

Length 21, diam. 12, aperture 10.5 mm.; whorls 6.

Length 17.8, diam. 11.2, aperture 10; whorls 5½.

This species is somewhat related to *A. porphyrea*, but it differs from all other related species by the colored parietal callus.

52. A. CYLINDRICA (Newcomb). Pl. 34, figs. 13, 14, 16.

"Shell dextral, elongately cylindrical, tapering to a point at the summit. Whorls 7, slightly rounded; suture moderate. Aperture oblong-ovate; columella terminating in a flexuous tooth. Surface of shell longitudinally strongly striate, of a

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light horn-color, encircled by numerous narrow brown bands. Length sixteen-twentieths, diam. six-twentieths of an inch" [20x7.5 mm.] (*Newc.*).

"Animal light gray, marbled with dusky triangular patches, mantle light gray, tentacles dark, granulations strong; a dorsal and two obscure lateral white lines extend from the head along the animal" (*Newc.*).

Oahu: Waianae (Newcomb); near Mt. Kaala (Thwing).

Achatinella cylindrica NEWC., P. Z. S. Lond., 1853, p. 134, pl. 22, f. 11 (1854); Ann. Lyc. N. H. of N. Y., vi, p. 325 (animal).—PFR., Monogr., iv, 555.—THWING, Orig. Descr., p. 156.

This shell has some resemblance to *A. frosti*, but that is smaller, with more straightly turrited spire, the last whorl shorter and more convex. In *A. variegata* the outlines of the spire are straight, while in *cylindrica* they are typically quite distinctly convex, as in Newcomb's figure which we have copied, pl. 34, fig. 13.

The embryonic shell has a rather narrowly conic shape, as in *A. variegata*, not so blunt and rounded as in *A. rubens*. It is very finely striate, as in *variegata*. In color it varies from purplish-red to whitish-corneous, but the lighter tint prevails.

Newcomb's measurement of the diameter was no doubt erroneous; his figure shows no such proportions as the assigned dimensions would indicate. Specimens received from him measure:

Length 18.5, diam. 9, aperture 7.8 mm.; 6½ whorls.

Length 18.3, diam. 9, aperture 8 mm.; 6½ whorls.

The adult shell has variously-placed spiral lines and zones of red-brown on a paler ground, which under the lens shows whitish striæ with fleshy or creamy intervals, giving a cream or fleshy appearance to the eye. Over this there is an extremely thin, dilute brown outer cuticle, worn off in front of the aperture, or sometimes extensively lost. The sculpture is strongly developed and rather irregular. The outer lip is a little thickened within. Fig. 16 was drawn from a typical specimen received from Newcomb (no. 57689 A. N. S. P.).

In the same lot with several typical specimens from Newcomb there is a narrower shell with almost straightly turrite

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spire (fig. 14) but having the sculpture and color of *cylindrica*.

Another lot in the Robert Swift collection (57690 A. N. S. P.) contains two shells banded with red-brown on a nearly white ground, two without the bands but otherwise similar. All have a thin light brown cuticle. One of these is drawn in fig. 14 of plate 34. It measures, length 21, diam. 9.8 mm.; whorls 7.

A. rubens has a thicker, blacker outer cuticle, a more obtuse apex, and less strong striation than *cylindrica*, but it must be admitted that there are specimens which seem to be intermediate between *rubens* and the bandless form of *cylindrica*. On the other hand, *cylindrica* approaches close to *A. intermedia*; yet the typical forms of these three species are abundantly distinct.

53. A. VARIEGATA (Pfeiffer). Pl. 34, figs. 1 to 5.

"Shell subperforate, rather solid, oblong-turrite; striate; brownish-buff variegated with streaks of brown epidermis. Spire turrited, the apex ruddy, rather acute; suture deep, not margined. Whorls 7, convex, the last two-fifths the total length. Columella indistinctly two-folded, the lower fold transverse, compressed, lamelliform, white. Aperture a little oblique, semioval. Peristome simple, unexpanded, acute, the columellar margin reflexed, overhanging, giving the appearance of a perforation. Length 17, diam. 8, oblique alt. of aperture 7, width 3½ mm." (*Pfr.*).

Sandwich Is. (Pfr.); Oahu: Mokuleia, north of the western end of the Waianae range (Gulick); Waianae valley (Baldwin); head of Boothes valley (Hartman).

Achatinella variegata PFR., Zeitschr. f. Malak., 1849, p. 90; Conchyl. Cab., p. 282, pl. 67, f. 14, 15; Monogr., iii, 466.—BALDWIN, Catalogue, p. 10.—*Achatinella rubens* REEVE (in part), Conch. Icon., pl. 6, f. 42*a*.—*Achatinella decepta* C. B. ADAMS, Ann. Lyc. N. H. of N. Y., v, p. 43; Contrib. to Conch., no. 8, p. 127.—*Amastra variegata* HARTMAN, Proc. A. N. S. Phila., 1888, p. 51.

It is a species of more turrited shape than *cylindrica* or *rubens*, the last whorl being shorter.

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The embryonic shell of 2¾ whorls is rather high and conic, purplish-red, darker at the tip, or rarely pallid. It is very finely and closely striate. Subsequent whorls have low wrinkle sculpture, strongest just below the sutures. The last whorl retains the thin, light olivaceous-brown cuticle in shreds. In adult shells it is entirely worn away in front of the aperture, and is generally darker, brown-streaked, behind the lip. The color below the outer layer of cuticle is pale brown. Interior white or faintly pink. The periphery remains acutely angular up to the 5 to 5½ whorl stage, then becoming rounded. There is an axial crevice behind the columellar lip. The "columella subbiplicata" mentioned by Pfeiffer is an occasional but inconstant feature, well developed in some shells, such as that drawn in fig. 5, but the upper fold is quite indistinct or wholly wanting in most individuals. The lip is thin-edged, and generally has a yellowish border within.

Length 17, diam. 8.8, aperture 7.25 mm.; 7 whorls.

Length 17.2, diam. 8, aperture 7 mm.; 7 whorls.

Figures 1, 2 are copied from Pfeiffer; figs. 3, 4, 5 and the above notes are from specimens from Mokuleia.

Section HETERAMASTRA Pilsbry (p. 141).

The single alleged Oahuan species referred to this group may prove to be a sinistral *Paramastra*, near *A. tenuispira* Baldwin, or perhaps it is not really from Oahu.

54. A. ELONGATA (Newcomb).

Shell sinistral, acutely turreted, with numerous well-defined longitudinal striæ, covered with a brown epidermis. Whorls 7, rounded; suture deep, simple. Aperture ovate; columella plicate; lip simple. Length 0.5, breadth 0.22 inch. Oahu (*Newcomb, A. elongata*).

Shell acutely turreted, sinistral; whorls 7, rounded; suture deep; striæ numerous, longitudinal and well defined; aperture ovate; lip simple; columella plicate; color of epidermis brown. But a solitary specimen of this shell has been found; but its characters are clearly marked, and no described species

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resembles it in form. Length 10, diam. 4½-twentieths of an inch. Lehui, Oahu (*Newcomb*, for *A. acuta*).

Oahu: Lihue, in the Waianae Range. Type in Newcomb coll., Cornell University.

Achatinella elongata NEWCOMB, Annals of the Lyceum of Nat. Hist. of New York, vi, May, 1853, p. 26; *t. c.*, Sept., 1858, p. 328 (identity of *A. acuta* and *A. elongata* affirmed and explained). — *Amastra elongata* SYKES, Fauna Hawaiiensis, p. 349.—Not *A. elongata* BORCHERDING, Zoologica, xix, p. 124, pl. 10, f. 24.—*Achatinella acuta* NEWCOMB, P. Z. S., 1853, p. 142 (not of Swainson; not P. Z. S., pl. 23, fig. 36 = *A. soror*).—PFR., Monographia, iv, 528.

Newcomb at first intended to name this shell *A. acuta*, but that name being in use, it was changed to *elongata* in the paper published in New York, which appeared before that in P. Z. S. under the name *acuta*. Both descriptions were based upon the same unique specimen, stated to be from Lihue, in the Waianae range, Oahu.

Borcherding follows Hartman in uniting *A. hutchinsonii* of Maui as a synonym of *elongata*. He figures a specimen from Waialua, near the eastern end of Molokai, which is clearly *villosa* Sykes, a form of *hutchinsonii*. We do not endorse this view. With a length of about 12 mm., *A. elongata* has 7 whorls. It is therefore only about half the size of *A. hutchinsonii* or *villosa*. The embryonic sculpture is unknown.

Newcomb subsequently procured additional specimens which he referred to *elongata*. Two of these, sent by him to Garrett, and now in the Bishop Museum, are certainly the Mauian *A. læva* Bald., one being quite typical, the other (pl. 49, fig. 10) is a wider form, 11x6 mm., having the shape of *interjecta*, but the rough sculpture, solid texture and white aperture of *læva*.

A. elongata has not been found by Oahuan conchologists of the present generation. Competent judges among them doubt the occurrence of such a shell on Oahu.

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AMASTRÆ OF LANAI.

The Amastræ of Lanai are closely related to those of Molokai. The *biplicata* series is especially developed, and the *assimilis* series of eastern Molokai and Maui is absent. *Amastrella* and *Cyclamastra* have not been found, but perhaps they may turn up as fossils, or even recent, as the island has not been very thoroughly explored. *Heteramastra* is represented by one species.

Key to Amastræ of Lanai.

a. Shell sinistral. *A. fraterna,* no. 55.

*a*¹. Shell dextral.

b. Shell globose-conic, 12x8.3, aperture 6.8 mm. *A. nucula,* no. 57.

*b*¹. Ovate-conic, oblong or turrited; aperture not over half the length.

c. Small, banded, with costate and carinate apex; 11.6x6 mm. *A. pusilla,* no. 56.

*c*¹. Large (over 18 mm.), embryonic whorls handsomely costate and usually carinate.

d. Whitish, fleshy or purplish under a fragmentary brown or blackish cuticle; length 25 to 36 mm. *A. magna,* no. 58.

*d*¹. A white peripheral band, spire brown; smaller. *A. m. balteata,* no. 58*a*.

*d*². Yellow under a deep brown cuticle; aperture yellow; length 23 to 25 mm. *A. aurostoma,* no. 59.

*d*³. Banded with brown; cuticle yellowish, dark behind the lip. *A. grayana,* no. 60.

*d*⁴. Yellow under the blackish cuticle; whorls shorter; aperture pink or red. *A. rubristoma,* no. 61.

*c*². Shell oblong-conic or turrited, the embryonic whorls finely striate; aperture usually pink; columella often biplicate.

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d. Yellow under blackish cuticle; last whorl strongly convex.
A. rubristoma, no. 61.

*d*¹. Whitish under blackish cuticle; last whorl rather compressed; length 20 to 23, diam. 11 mm. *A. biplicata*, no. 62.

*d*². Diameter usually more than half the length; length 14 to 20 mm.
A. durandi, no. 63.

*d*³. More slender, smaller, diam. less than half the length. *A. moesta*, no. 64.

Section HETERAMASTRA Pilsbry.

55. A. FRATERNA Sykes. Pl. 49, fig. 9; pl. 17, figs. 11, 14.

"Shell sinistral, ovate turriform, thin; suture impressed; whorls 6½ to 7, a little convex, longitudinally striated, covered with a brown or blackish-corneous epidermis. Aperture ovate, moderate; peristome unexpanded, acute; lamina moderate. Length 10, diam. 5.5 mm." (*Sykes*).

Lanai: Mountains behind Koela (Perkins).

Amastra fraterna SYKES, Proc. Malac. Soc. London ii, pt. 3, p. 129, October, 1896.—*Amastra* (*Laminella*) *fraterna* SYKES Fauna Hawaiiensis, p. 349, pl. 11, f. 23.

Mr. Sykes's original figure is copied in our pl. 49, fig. 9. The shell is more inflated than any of the *soror* group of Maui. It is entirely clothed with a thin, dark-brown or black cuticle, worn off in front of the aperture exposing the purple-brown under-color. The typical form has a nearly straight-sided spire and is composed of 6½ to 7 whorls (pl. 49, fig. 9).

A somewhat different form was collected by Mr. D. Thaanum, exact locality not given. It has fewer whorls and a concave-sided spire (pl. 17, figs. 11, 14). The embryonic whorls are very beautifully costellate, the riblets being narrow. They are represented as much too wide in pl. 17, fig. 14. The whorls are convex, the last one inflated; outlines of the spire concave. The columellar lamella is rather small, becoming larger within. The figures on plate 17 are from specimens collected by Mr.

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D. Thaanum. Length 10.3, diam. 6.5, aperture 5.3 mm.; 5½ whorls.

Subgenus AMASTRA *s. str.*

Imperforate or narrowly rimate Amastræ with the embryonic whorls typically flattened, costate, and carinate above the suture (the carina sometimes concealed), rarely they are convex and striate. Cuticle generally marked with zigzag or angular stripes or spots. Type *A. magna.*

Distribution: Molokai, Maui and Lanai.

The variation in embryonic sculpture which is occasionally encountered in this subgenus is extraordinary, though in the great majority of specimens and species only the costate and carinate type of embryonic shell is found. The main exceptions are in the series of *A. magna,* where the costation is weak in *A. violacea* and wanting in *A. nubilosa;* and the series of *A. nigra,* where that species has two embryonic forms, figured in pl. 43, figs. 1 and 3, and *A. subcrassilabris* has an embryo of the type shown in pl. 43, fig. 3. There are also a few other less aberrant cases of non-typical embryos in other series of the subgenus. This seems to be a case where the embryonic stage mutates independent of the later stages, a condition encountered in the *Muricidæ, Buccinidæ,* etc., and sometimes recognized under the term " heterostyly."

Series of A. pusilla.

Small Amastræ with the embryonic whorls costate and carinate, later whorls banded beneath a thin, yellowish, unfigured cuticle.

The single species placed here resembles *A. petricola* and *A. abavus* of Molokai in form and coloring, but differs entirely in embryonic sculpture. It is probably related to *A. tricincta* and its allies of Molokai.

✔ 56. A. PUSILLA (Newcomb). Pl. 17, figs. 8, 13, 15.

Shell dextral, conically ovate; apex acute; whorls 6, planoconvex; suture above but lightly impressed, below strongly marked; lip simple; columella short, with a twisted plait; epidermis light-brown, often encircled by narrow white bands.

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Length 14, diam. 4 twentieths of an inch, var. major. Length 8½, diam. 4 twentieths of an inch, var. minor. (*Newc.*)

Lanai (Newcomb).

Achatinella pusilla NEWC., Ann. N. Y. Lyc. Nat. Hist. vi, Oct., 1855, p. 144; Amer. Journ. of Conch., ii, 1866, p. 211, pl. 13, f. 5.—*Achatinella pulla* Newc., PFR., P. Z. S., 1855, p. 209 (Feb., 1856); Monographia iv, 546.

Pl. 17, figs. 8, 13, 15 were drawn from specimens received from Newcomb, representing his minor variety, which may be accepted as the typical form, since it is what he figured in 1866. The major variety, 17½ mm. long, noted in his description, is not known to us by specimens, and may be a distinct species. *A. pusilla* is the smallest *Amastra* of Lanai. With some resemblance to *A. petricola* of Molokai, this species differs entirely in the sculpture of the embryonic whorls.

The outlines of the spire are convex below, a little concave near the apex. The first smooth half whorl is followed by a flattened, strongly-ribbed whorl, carinate close above the suture, the ribs rather widely spaced. On the next whorl they become very fine and close, persisting on the upper part of the whorl, weaker below. 2⅔ whorls comprise the embryonic shell. The later whorls have growth-wrinkles only. The penultimate whorl is generally brown with cream-white bands bordering the sutures above and below. The last whorl may have creamy bands at suture, periphery and base (fig. 13) or there may be several above the periphery. In other specimens the last two whorls are of an opaque cream tint, with several spiral brown bands, as in fig. 15. A very thin yellowish cuticle, in part deciduous, covers the last whorl or two. The aperture is white within and has a strong lip-rib (not shown in the figures). The columellar lamella is subhorizontal.

Fig. 15. Length 11.25, diam. 6, aperture 5 mm.; whorls 6½.

Length 11.6, diam. 6, aperture 5.1 mm.

Series of A. nucula.

The following species seems to be related to the *nigra* series of Maui, and the *pullata* series of Molokai.

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57. A. NUCULA E. A. Smith. Pl. 26, fig. 9; pl. 39, figs. 11, 12.

"Shell globose-conic, dextral, striated with lines of growth, partly lightly malleated, dirty whitish, partly covered with a brown-olivaceous cuticle. Whorls 5½, the first 4½ rather flat, the last globose. Suture subcrenulate. Aperture whitish; peristome thickened; columellar fold thin. Length 12, diam. 8 mm. Habitat, probably on the island of Lanai." (*Smith*).

Lanai mountains (*Thwing*).

Amastra nucula SMITH, P. Z. S., 1873, p. 85, pl. 10, f. 19.—*Achatinella nucula* Smith, THWING, Occas. Pap. B. P. B. Museum, iii, no. 1, p. 168, pl. 3, f. 20.

"In this species the apex is not strongly radiately sulcated, as in *A. malleata*" (*Smith*).

The unique type of this species (no. 89 Gulick coll., Boston Society N. H.) is figured on pl. 39, figs. 11, 12, the original figure (copied in pl. 26, fig. 9) giving an inadequate idea of the shell, though correct in outline. The first whorl has been broken; the second is finely striate, the striæ close, arcuate, rather sharp and irregular. Subsequent whorls have light, irregular growth-wrinkles, in places a little enlarged near the suture, which however is not more crenulate than usual. The last whorl has a delicate ridge at the periphery in front, below which it is distinctly malleated, with forwardly-descending facets. Above the periphery the malleation is much weaker. Some specimens of *A. nigra* have a similar sculpture. The outlines of the spire are straight, but if the first whorl was present they would probably be a trifle concave. The early whorls are flesh-colored, the last two very pale-brown under a very thin, light, slightly yellowish-brown cuticle, which is worn away in front of the aperture, and becomes chestnut-colored close behind the outer lip. The aperture is formed much as in *A. pellucida* or *A. nigra*. The columellar lamella is subhorizontal, the curve below it deep and short, and there is a rather strong but narrow rib within the outer lip. Length, as broken, 11.5, diam. 8.3, aperture 6.8 mm.

This species has much the appearance of *A. pellucida* of Oahu, except that it is malleated; the color, shape and aper-

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ture being similar. It seems most closely related to the forms of *A. nigra* having rounded and striate embryonic whorls. There is no related species known on Lanai, and were it not for Mr. Thwing's acceptance of it as a Lanaian species, that locality might be doubted.

(*Series of A. magna.*)

58. A. MAGNA (C. B. Adams). Pl. 26, figs. 1 to 6; pl. 39, figs. 4, 8.

" Shell thick, ovate-conic, elongate; blackish-brown at the apex, reddish-brown on the middle whorls, and ash-colored on the lower whorls; with unequal, irregular, very coarse, transverse striae, with close-set transverse arcuate ribs near the apex, and some indistinct raised spiral lines on the lower part of the last whorl; apex subacute; spire rather long, with the oulines quite curvilinear; whorls seven, rather convex, with a well-impressed suture; last whorl obtusely angular; aperture ovate, acute above, with an extremely thick deposit on the inner side, with a very large compressed columellar fold.

Mean divergence 50°; length 1.33 inch; breadth .7 inch; length of aperture .61 inch.

The unique specimen which has served for this description is somewhat faded, and the lip probably is not quite mature, being sharp " (*Adams*).

Lanai (Newcomb, Gulick); behind Koele (Perkins).

Achatinella magna C. B. ADAMS, Ann. Lyc. N. H. of N. Y. v, p. 41 (1850); Contrib. to Conch., no. 8, p. 125.—NEWCOMB, Ann. Lyc. N. H. of N. Y. vi, 1858, p. 319 (animal).—PFR., Monographia iv, 542; vi, 177.—NEWCOMB, Ann. Lyc. N. H. vi, p. 319.—*Amastra magna* C. B. Ad., HARTMAN, Proc. A. N. S. Phila., 1888, p. 47.—SYKES, Fauna Hawaiiensis, p. 339.—BORCHERDING, Zoologica, xix, p. 106, pl. 10, f. 2.—GULICK, Evolution, Racial and Habitudinal, pl. 1, f. 19.—*Achatinella baldwinii* NEWCOMB, P. Z. S., 1853, p. 155, pl. 24, f. 72.—*Achatinella gigantea* NEWCOMB, P. Z. S., 1853, p. 136, pl. 22, f. 17 (Haleakala, Maui).

" Animal of inky-black above, veined with white, when ex-

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tended, as long as the shell; base of foot and mantle of a bluish-gray " (*Newcomb*).

A. magna differs from the related *A. violacea* of Molokai by its embryonic shell (pl. 26, fig. 5, length 6 mm., 3½ whorls). The initial half whorl is smooth; next two whorls strongly costate, and carinate above the suture; on the third whorl the ribs are finer than on the second. After the third whorl they become weak, persisting longest near the suture. The fully-formed embryo, as figured, is imperforate, acutely carinate, the carina white. The columellar fold is moderate and very oblique. In *A. violacea* the costation of the embryo is less strong and no supersutural carina is visible.

The last whorl varies from closely, subregularly striate to irregularly striate and malleate, the subperipheral portion often having revolving, flattened facets. Sometimes the periphery is angular, as in fig. 3. The blackish cuticle remains in shreds or lines between the striæ on the last whorl or two. There is great variation in the color of the aperture. It may be white (fig. 1) or cream-white (fig. 3), salmon-colored (fig. 2), or purple-brown or leaden-purple (fig. 4). *The parietal callus is very thick* in adult shells (thereby differing from *A. violacea*); it is pure white or dark-brown. The columellar fold is thin.

Fig. 4. Length 36.5, diam. 17, aperture 16.2 mm.; 7 whorls.

Fig. 1. Length 30, diam. 16.2, aperture 15.5 mm.; 6½ whorls.

Fig. 2. Length 30.5, diam. 15, aperture 13 mm.; 6½ whorls.

Fig. 3. Length 29.5, diam. 13.2, aperture 12.2 mm.; 7 whorls.

Fig. 6. Length 35, diam. 19, aperture 16.8 mm.; 7 whorls.

Length 35.5, diam. 15.5, aperture 1.5 mm.; 7⅓ whorls.

Length 25, diam. 12 mm.

The size varies widely. In shape it may be subcylindric, ovate or oblong-conic. It is likely that several subspecies will eventually be recognized, but a knowledge of the distribution of the forms is requisite for any step in this direction. Figs.

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4, 8, of plate 39, show shells retaining the cuticle, which is figured in characteristic patterns.

A. baldwinii Newcomb, was based upon a small example with the spire rather straightly conic, and the cuticle adhering in patches. Entirely similar shells are in several of the large lots of *magna* before us. Newcomb conceded its identity with *magna*. The original description and figure follow.

"*Achatinella baldwinii* (pl. 39, fig. 1). Shell dextral, conically elongate, striated longitudinally; whorls 7, slightly convex, not margined; suture simple, well-impressed; aperture elongate-ovate; columella long, with a white plicate tooth; lip acute, margined within with brown. Aperture bluish-white; labrum with a white deposit; color of shell light brown, with traces of a thin black epidermis; first four whorls black. Length 2.1, diam. 10 twentieths of an inch. This species is dedicated to the Rev. Mr. Baldwin of Lahaina. It belongs to the limited group of *A. gigantea* and *A. violacea*. There has been but one specimen as yet obtained" (*Newc.*).

Ranai. Length 21, diam. 10 twentieths of an inch (*Newc.*).

Achatinella gigantea Newcomb has been considered a synonym of *violacea* by Pease, Hartman, Borcherding and Sykes, who remarks that probably the locality of Maui, given by Newcomb, was an error, as his specimen appears to be only an elongate form of the Molokai shell. Specimens received from Dr. Newcomb are certainly *A. magna*. The callosity "continued to unite with the outer lip" is a character of *magna*, not of *violacea*. It seems to be an absolute synonym of *magna*. The original description and figure are copied: "*Achatinella gigantea* (pl. 40, fig. 1). Shell dextral, elongate-ovate, apex pointed; whorls 7, strongly striate, slightly carinated superiorly on the last whorl, inferiorly on the penultimate; columella slightly arched, terminating internally in a slight callosity; externally continued to unite with the outer lip; columellar lip with a strong deposit spread over its surface; outer lip simple; suture deep; striæ longitudinal; color light plumbeous externally, internally pale lilac. Length 1½, diam. 12 twentieths of an inch. Haleakala, Maui" (*Newcomb*).

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Among the specimens of *A. aurostoma* sent by Mr. Baldwin, there is an interesting shell showing some characters of *aurostoma,* though the *magna* type predominates (pl. 26, figs. 11, 12). The ground color is pale-brown on the last two whorls, red-brown above. The cuticle is dense, unbroken and nearly black on the last two-thirds of the last whorl. The striation is more pronounced than in *aurostoma,* and the lower half of the last whorl is conspicuously malleate, a feature not very clearly indicated in the figure. The aperture is yellow within, as in *aurostoma,* but some *magna* have the same color. Length 24.2, diam. 11.5 mm.

Color-var. *balteata* n. v. (pl. 26, figs. 7, 8). A small form in which the spire is brown, last whorl gradually becoming lighter, whitish in its last third, and encircled by a white peripheral band, visible as an angular white line close above the suture on the spire. Embryonic whorls costate and carinate. No cuticle remains; striation well developed on the last whorl. Aperture small, acutely ovate, somewhat periform, flesh-colored inside. Columellar fold small and oblique. Length 23.6, diam. 12.3, aperture 11 mm.; whorls 6⅓ (fig. 8).

59. A. AUROSTOMA Baldwin. Pl. 26, figs. 13, 14.

The shell is imperforate, oblong-conic, solid, yellow under a dark chestnut cuticle, which is smooth, rather glossy, and on the spire streaked with yellow; apex red-brown. Embryonic whorls costate and carinate, the carina very close to the suture. Subsequent whorls slightly convex, with sculpture of low striæ, which are weaker on the last whorl, which is regularly elliptical and not malleate. The aperture is ovate, *yellow within;* outer lip without a lip-rib. Columella yellow, bearing a strong fold of the same tint. Parietal callus tinted, typically thick.

Fig. 13. Length 25, diam. 12.6, aperture 11 mm.; 6½ whorls.

Fig. 14. Length 23.5, diam. 12, aperture 11.8 mm.; 6½ whorls.

"Animal when extended in motion as long as the shell; mantle dark slate, margined on the outer side with reddish-

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brown. Foot above and below very dark brown, the sides studded with large patches of darker hue, the posterior portion tinged with red. The head above and tentacles covered with almost black granulations" (*Baldwin*).

Lanai (Walter H. Hayselden).

Amastra aurostoma BALDWIN, Nautilus, x, July, 1896, p. 31.

This species stands close to small forms of *A. magna*. It is smoother, of a brighter yellow color under the cuticle, which is more persistent. The last whorl is more regularly elliptical than usual in *magna*. The description and figures 13 and 14 are from cotypes received from Mr. Baldwin.

The cuticle is typically dense and dark on the last whorl.

In some specimens (no. 2232 coll. C. M. Cooke) the cuticle is much worn. In others it is closely mottled on the penultimate and front of last whorl. Probably intergrading forms with *A. grayana* will be found.

60. A. GRAYANA (Pfeiffer). Pl. 39, figs. 2, 3.

Shell imperforate, dextral, ovate-conic, rather solid, somewhat shining, grayish-flesh colored, variously marked with chestnut bands disappearing above. Spire inflated-conic, the apex acute, black; whorls 6½, the upper ones flat, radially plicate, the penultimate convex, last whorl nearly as long as the spire, lightly striate. Aperture subvertical, acuminate-oval. Columellar fold median, subtransverse, triangular; peristome simple, unexpanded, the columellar margin slightly dilated, adnate. Length 21.5, diam. 12 mm. Sandwich Is., D. Frick (*Pfr.*).

Lanai: Lanaihale, a ground shell (Perkins).

Achatinella grayana PFR., P. Z. S., 1855, p. 204, no. 13; Monographia, iv, 554.—*Amastra grayana* SYKES, Fauna Hawaiiensis, p. 337, no. 22.

It has been recorded from Oahu, evidently in error, since no Oahuan species has flat, radially plicate upper whorls. Two specimens in the C. M. Cooke collection, received from D. D. Baldwin are figured. In these shells (pl. 39, figs. 2, 3), which are not localized nearer than "Lanai," the cuticle is olivaceous yellow marked with darker or reddish-brown

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spiral lines on the penultimate and sometimes the periphery of the last whorl, becoming blackish or dark-brown behind the lip. Under the cuticle the last whorl or two is light-yellow, as exposed in front of the aperture. Apex reddish or purplish brown, costate, but the carina is almost concealed in the suture. Interior of aperture pink or white.

Length 21, diam. 10.2, aperture 9.8 mm.; whorls 6¼.

Length 19.5, diam. 11, aperture 10 mm.; whorls 6.

This species stands very close to *A. aurostoma* which differs by its thicker, darker cuticle, without bands; it is also larger than *grayana*. (Named for J. E. Gray, then keeper of the zoological department of the British Museum.)

61. A. RUBRISTOMA Baldwin. Pl. 39, figs. 5, 6.

"Shell dextral, imperforate, solid, elongately ovate-conic, apex acute; surface striated with irregular growth striæ; nuclear whorls radiately sulcated. Color reddish-brown, sometimes almost white, upper whorls darker; generally covered with a dark fugacious epidermis. Whorls 7, convex, suture well impressed. Aperture a little oblique, oval, red within, sometimes livid-white. Peristome acute, very slightly thickened within. Columella terminating in a strong arched lamellar plait, tinged with red. Length 19½, diam. 12 mm" (*Baldwin*).

Lanai (D. Thaanum).

Amastra rubristoma BALDW., Nautilus, xix, April, 1906, p. 137.

This species stands close to *A. aurostoma*, from which it differs by the much shorter whorls. It stands intermediate between *aurostoma* and *biplicata*, differing from the latter by its more rotund last whorl, the yellow under-color and the more glossy surface. No specimens are well enough preserved to show whether the embryonic sculpture is that of *aurostoma* or of *biplicata*. The type specimens are figured. Of the three, one is entirely denuded of all cuticle, dull and flesh-colored, a little yellowish on the last whorl, darkening near the apex and behind the lip (fig. 6). The other shells are unworn. They have a glossy yellow under-skin, mainly cov-

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ered by a thin, much-worn blackish-brown cuticle. The apical whorls are reddish, worn in all of the specimens, but they seem to show traces of costation; the keel, if any, is nearly or quite concealed in the suture. The subsequent whorls are weakly marked with growth-lines, rather glossy, and strongly convex. Aperture bright pink within in the two larger shells, merely pinkish-white in the smallest. The pink lip-rib is strong or rather weak. The well-developed columellar fold is median and quite oblique.

Length 19.3, diam. 11.7, aperture 9.2 mm.; 6½ whorls.
Length 19.3, diam. 11.4, aperture 8.9 mm.; 6½ whorls.
Length 17, diam. 11, aperture 8 mm.; 6⅓ whorls.

Series of A. biplicata.

Embryonic shell purple-brown, very finely sharply striate, the whorls somewhat convex. Adult stage oblong or turrite, partly covered with a blackish deciduous cuticle, which is variegated on the intermediate whorls. Columella with one *or two* folds and, with the parietal callus, usually pink.

The sculpture of the embryonic shell is stronger than in the Oahuan group of *A. turritella,* and the apex is somewhat more pointed, but the resemblance is perhaps indicative of relationship. It should be noted that in the turritella series also there is a tendency to form a second columellar fold, in rare individuals. The variegated cuticle of the neanic stage allies the *biplicata* group to typical *Amastra* of Lanai and Molokai, from which it differs by the convex, striate, not costate, embryonic whorls—a character variable in *Amastra.*

Species are known from Lanai and Molokai. Data for mapping the range of the Lanaian forms are wanting. We have as yet only scanty information on the details of distribution in this island.

62. A. BIPLICATA (Newcomb). Pl. 17, figs. 1 to 6.

Shell dextrorsal, elongately cylindrical; whorls 7, rounded, longitudinally strongly striated; suture deep; aperture small, subovate; inner lip rather callous; columella biplicate; outer

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lip acute, submarginate within; color rosy, partly concealed by a thin brown epidermis; upper whorls black; aperture red within. (*Newc.*)

No dimensions; figure measures 23 x 12 mm.

Lanai (Newc.); Waiapaa and Koele (Perkins).

Achatinella biplicata NEWC., P. Z. S., 1853, p. 156, pl. 24, f. 75 (1854).—THWING, Orig. Descriptions, p. 168, pl. 3, f. 19.—*Amastra biplicata* NC. SYKES, Fauna Hawaiiensis, p. 334.

A variable shell, sometimes quite elongate, sometimes shortened, but typically easy to recognize by the biplicate columella and more or less deeply pink aperture. An embryonic shell 3.8 mm. long, of nearly 3 whorls, has an angular periphery, moderate columellar fold and no perforation. The first half whorl is smooth; next whorl finely and sharply striate, and the following whorl is much smoother. The embryonic whorls are invariably dark purple-brown. Later whorls of the shell are quite convex, with rather low, coarse, irregular growth-wrinkles. Cabinet specimens are whitish under the dense black or black-brown cuticle, which may be nearly continuous or very extensively deciduous. On the intermediate whorls the cuticle is generally mottled, or remains in forwardly descending stripes, which are probably due to an oblique malleation of the surface. The aperture is pink-tinted or white within, the outer wall is sometimes thin, but generally thickened by a heavy deposit of callus, forming a low entering ridge above the middle of the outer lip. This has been noticed in few *Amastras*. The columella and parietal wall are pink. The columella usually bears two subequal, oblique folds, but occasionally the upper one is weak or entirely wanting, and in one shell examined (no. 13433, Boston Society) there is no trace of an upper fold, and the lower one is reduced to a low truncation of the columella.

Length 23, diam. 11, aperture 9 mm.; 7⅓ whorls.

Fig. 4. Length 20.5, diam. 11, aperture 9 mm.; 6½ whorls.

Fig. 6. Length 22, diam. 10.2, aperture 8.9 mm.

A. durandi Ancey, said to be from Waianae, Oahu, but known to occur on Lanai, is apparently the most closely re-

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lated species. It differs chiefly in being smaller and more slender than *biplicata*.

63. A. DURANDI Ancey. Pl. 39, figs. 7, 9, 10.

"Shell imperforate or nearly perforate, conoid-oblong, solid; fleshy-whitish under a black-brown epidermis which is partly deciduous, and sometimes lightning-streaked above; somewhat glossy, lightly striate, the apex nude, blackish-purple. Spire conic-turrite, acute. Whorls 7, the first sharply and closely striate, nearly flat, those following convex, parted by a narrow and simple suture, the last whorl oblong, rotund. Aperture suboblique, sinuate-semioval, angular above; parietal wall and columella glossy reddish, the rest concolored, interior pale rose-white. Columella provided above with two oblique, acute and equal folds. Peristome acute. Length 15.5, diam. 8, alt. apert. 6 mm." (*Anc.*)

Lanai (Pease, in U. S. Nat. Mus.; Cooke coll.)

[Waianae, Oahu, E. Durand.]

Amastra durandi ANCEY, Le Naturaliste, xix, 1897, p. 178.

"This interesting species is incontestably closely related to *A. biplicata* of the island of Lanai, and may be considered a derivative form of that which has had an independent development on another island. It is remarkable for the two quite equal columellar folds, while in its congener they are slightly unequal, a size smaller than *A. biplicata*, and a more brightly colored aperture" (*Ancey*).

Mr. Ancey's description and remarks are given above. The locality given by him was undoubtedly erroneous. Eight specimens of the species from Lanai are before me: one from the National Museum, no. 42408*a*, three from the Cooke collection, no. 2230, and four from the Boston Society, nos. 13432 and 13434. In having finely striate dark-purplish embryonic whorls it is like *A. mœsta*. The very shallow protractive depressions, retaining dark cuticle on the intermediate whorls of some specimens are also found in *mœsta* and *biplicata*. The columella is like that of *A. biplicata*. The two folds may be subequal, or the upper one may be wider or more oblique. There is sometimes a heavy callus within the

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mouth, above the middle of the outer margin, as in *A. biplicata*. The largest shells have 7½ whorls, the smaller ones 7.

Length 20, diam. 9.2, aperture 7.9 mm.

Length 20, diam. 8.5, aperture 7.1 mm.

Length 17.5, diam. 8.3, aperture 7 mm.

Length 18.3, diam. 7.9, aperture, 7 mm.

Fig. 9 is from no. 42408*a*, U. S. Nat. Mus.; fig. 10 is one of three shells in no. 13432, Boston Society, a much stouter variety, which may represent another subspecies, length 14, diam. 8 mm., aperture 6.9 mm.; 6⅓ whorls.

64. A. MŒSTA (Newcomb). Pl. 17, figs. 7, 9; pl. 26, fig. 10.

" Shell dextrorsal, turrito-conical; whorls 7, convex, longitudinally striated; aperture small, ovate, slightly contracted; columella straight with a strong white spiral callus in the middle. Color reddish-brown; the upper whorls black; the middle with black zigzag lines, the last covered with a dark-brown epidermis " (*Newc.*).

No dimensions given; figure measures, length 18, diam. 7.9 mm.

Lanai (Newc.).

Achatinella mœsta NEWC., P. Z. S., 1853, p. 157, no. 77, pl. 24, f. 77 (1854).—PFR., Monogr., iv, 555.—*Amastra mœsta* SYKES, Fauna Hawaiiensis, p. 340.—*Achatinella obscura* NEWC., P. Z. S., 1853, p. 157, no. 78, pl. 24, f. 78 (1854).—*Amastra longa* SYKES, Proc. Malac. Soc., London, ii, Oct., 1896, p. 129; Fauna Hawaiiensis, p. 339, pl. 11, f. 35.

Distinguished by its slender and elongate shape, like some East Mauian species, but very unlike them in the sculpture of the embryonic whorls. After the smooth initial half-whorl there are two whorls with fine, close, sharp striation (shown too coarse in pl. 26, fig. 10). Later whorls have low growth-wrinkles. The first 3 or 4 whorls are dark purple-brown, the last two whorls very pale brown or creamy, partly covered with a thin blackish cuticle, which is mottled or obliquely striped on the intermediate whorls, and is sometimes almost wholly deciduous. The aperture, columella and parietal callus are flesh-colored. Columella short, bearing a stout median

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fold, and often a very low, more oblique rudimentary upper fold.

Fig. 7. Length 15.8, diam. 7, aperture 6 mm.; 7 whorls.

Fig. 9. Length 15, diam. 6.5, aperture 6 mm.; 6⅓ whorls.

64*a*. Var. *obscura* (Newcomb). Pl. 17, figs. 10, 12.

The form called *A. obscura* has been considered a synonym of *mæsta* by Pease, Hartman and Sykes. It differs only in being a little more slender. The figures represent shells received from Newcomb. The brown or dull olive cuticle may be merely streaked (fig. 12) or it may be mottled and marked with angular lines (fig. 10). As in *mæsta* proper, there is sometimes a keel visible above the suture on some intermediate whorls.

Fig. 12. Length 16.5, diam. 6.5, aperture 5.7 mm.; 7 whorls.

Fig. 10. Length 13.3, diam. 5.5, aperture 5 mm.; 7 whorls.

Length 13, diam. 5.2 mm.

Length 12, diam. 5.8 mm.

Newcomb gave no dimensions. His description follows: "Shell dextrorsal, turrito-conical; whorls 7, longitudinally striated, rather convex, marginate superiorly; suture slightly impressed. Aperture small, ovate; columella subtortuous, furnished with a spiral lamina; outer lip acute, simple; color dirty fulvous, covered with a blackish-brown epidermis; the upper whorls black. Island of Ranai."

64*b*. Var. *longa* Sykes. Pl. 26, fig. 15.

"Shell dextral, long, subperforate, solid, substriate, covered with a black-brown epidermis; the apex rather acute; suture simple. Whorls 7, moderately flat, the last more than half the length of the shell. Aperture sinuate-semioval, whitish inside; columella slightly folded above, provided with a small transverse lamina; peristome simple, unexpanded. Length 11.75, diam. 6.5 mm.

"Lanai (Newcomb); Windward side of Lanai, apparently extinct (Perkins).

"This is one of those species which are fast disappearing

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from the fauna of the Hawaiian Islands, or are, indeed, already extinct. The two specimens found by Mr. Perkins have lost their periostracum, but others in the British Museum, collected forty years ago, are in far better condition. The species is, in form, of the group of *A. turritella* Fér., and has the blackish periostracum usually found on the species of *Amastra* from Lanai " (*Sykes*).

The figure published by Mr. Sykes does not seem to represent the type-specimen, as the length is indicated as 17 mm. Possibly the length " 11.75 " is an error for 17.5 mm. No comparison seems to have been made with *A. mœsta;* and as no differential characters are given, I admit it as a variety with some hesitation.

Amastræ of Molokai.

Molokai is formed of a lower western mass culminating in Mauna Loa, 1382 ft. elevation, and a higher, deeply-furrowed, forested, eastern mass. The western half is dry and unforested, having been in very much this condition for at least a century. So far as we know, not a single land shell is known from this region, but it was probably once forested, and if so, fossil shells will probably be found. Possibly some still survive in the higher, rougher portions, but so far as we know, none have been reported.

" The only forest now remaining in the mountains of Molokai is found at elevations above 1500 feet at the east end of the island. This forest is inaccessible [for economic purposes] on account of the precipitous character of the mountains."

It is in this forest that the Molokaian snails live.

While the Amastræ of Molokai are on the whole closest to those of Maui, yet their relationship to those of Lanai is hardly less intimate. The Laminellæ are nearer those of Maui.

The *Achatinellidæ* of Molokai have been treated monographically by Herr Fr. Borcherding, in his *Achatinellen-Fauna der Sandwich-Insel Molokai,* Zoologica, xix, Heft 48, 1906; 196 pp., with 9 beautiful colored plates and a map. It is an excellent and useful work. I hesitate to mention that in my

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opinion the errors of identification are somewhat numerous, because in the present state of the subject, certainty is unattainable in dealing with Molokaian Amastras and Laminellas.

Most of the cases cited by Borcherding of *Achatinellidæ* occurring on two or more islands are either based on faulty data, or in some cases rest upon a wider conception of "species" than the authors have used in this work. So far as we know, *Amastra hutchinsonii* is the only Molokaian species of this genus which is common to another island (Maui), though several forms of the *assimilis* group of eastern Molokai and Maui are closely related.

Key to Amastræ of Molokai.

I. Shell deeply umbilicate, small (length about 9 to 11 mm.), brown. *A. umbilicata*, no. 65.

II. Shell rimate or imperforate.

a. Shell sinistral.

b. Small, 11.5x5.5 mm., with weak sculpture. *A. perversa*, no. 82.

*b*¹. Larger, length 15 to 25 mm.; roughly sculptured. *A. hutchinsonii*, no. 89.

*a*¹. Shell dextral.

b. Embryonic whorls finely striate.

c. Small, length 9 to 12 mm.; banded; no angularly striped cuticle.

d. Moderately solid, brown with a subsutural whitish band. *A. petricola*, no. 66.

*d*¹. Very solid, lip, columella and parietal callus thick; fossil. *A. abavus*, no. 67.

*c*¹. Larger, length over 15 mm.

d. Cuticle dense, black, variegated on spire; dull red within the lip; 16 to 18x9 mm. *A. humilis*, no. 68.

*d*¹. Striation very weak; closely speckled and ragged-striped on a cream or pale fleshy ground; lip white within.

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e. Rather narrow, with strongly convex whorls 16x9.5 to 22.3x11 mm.
A. nubilosa, no. 70.

*e*¹. Spire more conic, last whorl more ample; 20x12 to 25x14 mm.
A. n. macerata, no. 70a.

*d*². Only some shreds of cuticle remaining; striate; violaceous or flesh-colored.

e. About 29x14 mm. *A. violacea,* no. 69.

*e*¹. Larger, more ashen.
A. v. wailauensis, no. 69a.

*b*¹. Embryonic whorls costate and carinate, or with the carina concealed in the suture.

c. Last whorl dark or covered with an olive or dark cuticle, sometimes banded or streaked but not mottled or zigzag-striped.

d. Small (length 8 to 12 mm.), with one to three white spiral bands; thin, ovate-conic.

e. Dark brown with white bands at suture, periphery and base; 8.8x5 mm. *A. tricincta,* no. 80.

*e*¹. Pale brown, lighter at suture, a white band at the periphery; 11.8x6.9 mm.
A. elegantula, no. 81.

*d*¹. Oblong conic, with somewhat streaked olive-brown cuticle on last whorl; rather small.

e. Length 12, diam. 6 mm.
A. subobscura, no. 79.

*e*¹. Length 16.5 to 17, diam. 8 to 9 mm.
A. m. dimissa, no. 78a.

*d*². Rather large, length 15 to 23 mm.; wider; last whorl covered with dark-brown or black cuticle; spire sometimes mottled, zigzag-striped.

e. Diam. decidedly more than half the length.

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f. Ovate; last whorl covered with dark cuticle. *A. pullata*, no. 71.

*f*¹. Globose-conic; last whorl light above, dark below periphery; 15x10 to 16x9.3 mm. *A. seminuda*, no. 72.

*e*¹. Diam. half the length, more or less; narrower shells.

f. Dense black cuticle on last whorl, often streaked or zigzag on penult.; 20x10 to 11 mm. *A. uniplicata*, no. 73.

*f*¹. Very little cuticle remaining; last whorl generally malleate; 19x 10.5 mm. *A. borcherdingi*, no. 74.

*d*². Length 28 to 38 mm.; very little cuticle; fleshy, violaceous or gray. *A. violacea*, no. 69.

*c*¹. Cuticle decorated with zigzag or angular markings, sometimes wanting.

d. Globose-conic, the diam. about ¾ the length; aperture more than half the length. *A. sykesi*, no. 76.

*d*¹. Ovate or oblong-conic, narrower; aperture half the length or less.

e. Ground-color yellow. *A. citrea*, no. 75b; *A. atroflava*, no. 75c.

*e*¹. Ground-color brown, fleshy or whitish. *A. borcherdingi*, no. 74; *A. mucronata*, no. 75; *A. simularis*, no. 75; *A. nubifera*, no. 77.

Section CYCLAMASTRA Pils. & Van. (p. 147).

65. A. UMBILICATA (Pfeiffer). Pl. 36, figs. 6, 7.

Shell very narrowly but openly umbilicate, dextral, ovate-conic, thin, striate, opaque, brown; spire a little concavely conic, the apex acute. Whorls 6, but slightly convex, the last a little shorter than the spire, angular at base. Aperture el-

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liptical, angular at both ends; columellar fold compressed, deep, subtransverse. Peristome simple, acute, the columellar margin somewhat dilated, and free throughout. Length 10½, diam. 5⅔ mm. (*Pfr.*)

Oahu (D. Frick in Cuming coll.; see below); Molokai (Newcomb); Mapulehu (Baldwin).

Achatinella umbilicata PFR., P. Z. S., London, 1855, (Feb., 1856), p. 205, no. 15, no locality. Malak. Blätter, 1856, p. 165; Monographia, iv, 557 (Oahu, Frick).—*A.* (*Amastra*) *umbilicata* Pfr., HARTMAN, Proc. A. N. S., Phila., 1888, p. 50, pl. 1, f. 11.—BALDWIN, Catalogue, 1893, p. 10.—*Achatinella petricola* var., NEWC., Amer. Jour. of Conch., ii, p. 211, pl. 13, f. 6.

This species was described by Dr. Pfeiffer from a specimen sent to Cuming by Frick, at first without locality, but later with the locality Oahu. Dr. Newcomb in his Synopsis of the genus Achatinella, 1858, p. 334, placed it as a synonym of his *A. petricola,* from Molokai, a position he upheld later in the American Journal of Conchology, II. As Newcomb's shells agree fully with Pfeiffer's description, we accept his identification, and figure a specimen received from him, discrediting the locality Oahu, assigned on the authority of Frick.

Differs from *A. petricola* by its larger umbilicus, thinner, unicolored shell, the more slender spire, and the smaller, more oblique columellar fold. In the specimens seen there is no thickening within the outer lip. The two species are not very closely related.

The color is a rather light-brown, darker at the apex. The embryo is possibly striate when quite fresh and unworn, but is smooth in the specimens examined. Whorls more convex than in *A. petricola.* The umbilicus is circular in a basal view, and penetrates deeply, but is rather broadly overhung by the columellar lip; an obtuse ridge bounds it, being emphasized by a spiral excavation just within its edge. The aperture is angular at the junction of the columellar and basal margins. The columellar margin is triangularly dilated, and bears a small, quite oblique fold, which emerges more than that of *A. petricola,* nearly to the edge. There

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are traces of a very thin, brown, outer cuticle. The specimen described above and figured is not quite adult, judging by the very thin outer lip. Length 9, diam. 5, aperture 4.1 mm.; 5½ whorls. A shell in coll. U. S. Nat. Mus. is almost exactly similar.

This species is certainly very close to *A. morticina* of West Maui, but in that the whorls are perceptibly shorter, the striation a little more distinct, and the suture crenulated. The upper part of the spire in *A. umbilicata* and *A. morticina* tapers more than in *A. similaris*.

Section AMASTRELLA (p. 151).

Series of A. petricola.

Small forms with finely striate embryonic whorls; later stages streaked or banded, without zigzag lines or fine mottled pattern.

The apical sculpture is not unlike that of the *biplicata* group, of Lanai. The other characters of the shell point to *Amastrella* as most nearly akin.

66. A. PETRICOLA (Newcomb). Pl. 36, figs. 4, 5.

"Shell dextral, acutely conical, longitudinally coarsely striate; whorls 6, rounded, sometimes the last one inflated; suture simple, well impressed; aperture rounded ovate; lip acute, slightly thickened within; columella rather long, with a sub-central revolving plait; often with an umbilicus; color dark corneous, outer and columellar lips margined externally with white or yellowish-white" (*Newc.*).

Length 5, diam. 2 inch. (*Newc.*).

Molokai: on the rocky sides of a pali or precipice (Newcomb). Mapalehu (Baldwin).

Achatinella petricola NEWC., Ann. Lyc. Nat. Hist. of N. Y., vi, 1855, p. 143; P. Z. S., 1855, p. 208; Amer. Jour. of Conch., ii, p. 211.—PFR., Monogr., iv, 558.—*Amastra petricolor* BALDWIN, Catalogue, p. 9.—*A. petricola* SYKES, Fauna Hawaiiensis, p. 341 (exclusive of *Achatinella umbilicata* Pfr.).—BORCHERDING, Zoologica, xix, p. 122, but not pl. 10, f. 22, from Kamalo.

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Newcomb has related in great detail his adventures in collecting this snail, but did not mention the location of the *pali* where he found it—information more useful if less thrilling. We do not know exactly what form Mr. Baldwin reports from Mapalehu, which is on the southeastern slope.

Newcomb declared *A. umbilicata* Pfr. to be connected with *petricola* by intergrading specimens, a view accepted by Pfeiffer in the Monographia, and also by Sykes and Borcherding. Hartman kept them separate, I believe correctly. The two species were mixed in material sent out by Newcomb, and both were included in his several descriptions, though the *umbilicata* form only incidentally, in the two phrases "sometimes the last one inflated" and "often with an umbilicus." The form figured by Borcherding is evidently neither *petricola* nor *umbilicata*.

A. petricola is ovate-conic with the outlines of the spire barely convex, nearly straight. The embryonic shell has extremely fine longitudinal striæ, the later whorls rather coarse, low, growth-folds. The shell is of a slightly olive-tinted brown color, the embryonic whorls the same or purple-black. After the embryonic stage there is a yellow line below the suture, becoming a well-defined band on the last 1½ or 2 whorls. Back of the lip there is a rather broad yellow streak, which extends to the umbilical region where it forms a yellow crescentric patch around the narrowly umbilicate axis. There is a sort of obtuse ridge around the umbilicus. The outer cuticle, visible in fresh specimens, under a lens, is an excessively thin, dull, light-brown film over the glossy under layer, which shows in angular patches. Outer lip acute, margined with a white callus within. Columella vertical, its edge reflexed in a narrow triangle, overhanging the umbilicus, and slightly channeled at the junction with the basal lip. It bears a rather strong fold, which terminates rather far from the margin.

Length 10.2, diam. 5.9, aperture 3.9 mm.; 5½ whorls.

Length 9.2, diam. 5 mm.; 5½ whorls.

The specimens described and figured are from Newcomb, and presumably part of the original lot.

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A specimen in U. S. Nat. Mus. (part of no. 117273), measuring length 9, diam. 5 mm., aperture 4.5 mm., has a half-open umbilicus intermediate in size between that of typical *petricola* and *umbilicata*. It is rather solid, with the color of *petricola*.

67. A. ABAVUS n. sp. Pl. 42, figs. 4, 5.

The shell is imperforate, ovate-conic, very *thick and solid*, rather glossy; fossil, and therefore without cuticle. Color (1) first 2½ whorls pale brown, next half whorl with brown bands and white ground, last two whorls opaque white, or (2) pale brown with white bands beginning on the penult. whorl, predominating on the last whorl. Outlines of the spire a little convex below, straight above, the apex obtuse. Embryonic whorls convex, very finely striate, the first whorl nearly smooth. Following whorls weakly convex with the usual sculpture of fine growth-lines. Aperture small, indistinctly angular at the base of columella; *the outer lip very much thickened within;* columellar margin thick, bearing a small, subhorizontal lamella; parietal callus very thick out to the edge.

Length 10.8, diam. 6.3, aperture 5 mm.; 5½ whorls.

Length 11, diam. 6, aperture 5.1 mm.; 5½ whorls.

Molokai: Pukoa, fossil. Cotypes to be deposited in Bishop Museum, collected by Mr. D. Thaanum.

This species is very closely related to *A. petricola*, from which it is readily distinguished by the solid shell with very thick lip, columella and parietal callus.

Subgenus AMASTRA (p. 234).

Series of A. biplicata (p. 243).

This series, otherwise Lanaian, has one species in central Molokai.

68. A. HUMILIS (Newcomb). Pl. 40, figs. 7, 8.

"Shell elongately conical, longitudinally rudely striate; whorls 7, rounded above, flattened centrally; last one obscurely carinated superiorly; suture deep, simple; apex acute;

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aperture subrounded; lip acute, slightly thickened within; columella flattened with a thick plait; color of shell pale salmon, covered with a densely black epidermis; columella and deep margin of the outer lip within dark-brown; interior of aperture bluish-white. Length .7, diam. .35 inch" (Newc.).

Molokai: Kalai [Kalae], on the ground under low bushes (Newcomb, type loc.); Makakupaia (Perkins); Kamalo (Borcherding); all in the central part of the island.

Achatinella humilis NEWC., Ann. Lyc. Nat. Hist. of N. Y., vi, October, 1855, p. 143; P. Z. S., 1855, p. 207; Amer. Journ. of Conch., ii, p. 211, pl. 13, f. 4.—*Amastra humilis* Newc., BALDWIN, Catalogue, p. 9.—SYKES, Fauna Hawaiiensis, p. 337.—BORCHERDING, Zoologica, xix, p. 119, pl. 10, f. 21.

The specimens figured were received from Newcomb. The shell is hardly "obscurely carinated" but only turgid below the suture, or sometimes so swollen there as to appear obtusely subangular, an appearance aided by the wear of the cuticle from the convexity. The purple-brown embryonic shell is very finely but sharply striate, as in many Oahuan species. The following one or two neanic whorls are covered with black or blackish-olive cuticle, marked with whitish streaks and zigzag figures, and fading to whitish near the suture above; often partially lost. The last whorl is white or brown-tinted under a dense black cuticle of which small patches are lost. There is usually but not always a nude patch in front of the aperture. The interior is dull bluish-gray, with a red-brown or dull rose streak on the low callus within the lip, which is quite acute. The columella is dull purplish. It usually bears a single paler moderate fold, but there is sometimes a second more oblique and much smaller fold above the principal one.

Length 17.2, diam. 9, aperture 7 mm.; whorls 6½.

Length 16.2, diam. 8.9, aperture 7 mm.; whorls 6⅓.

There are indistinct traces of a vermiculate-mottled pattern, like *nubilosa*, on the spire of *A. humilis*. It seems to be more closely related to *A. biplicata* of Lanai than to any other species. *A. humilis* is isolated in the Molokai fauna.

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Series of A. magna (p. 237).

Large Amastræ with the embryonic whorls varying from costate and carinate to finely striate without visible keel; later whorls having the thin cuticle mottled or zigzag-striped, sometimes almost wholly deciduous.

Related to the much smaller shells of the *assimilis* group.

69. A. VIOLACEA (Newcomb). Pl. 27, figs. 3, 4.

Shell dextral, ovate-oblong, solid; whorls 7, convex, strongly striate longitudinally; suture plain and deeply impressed. Aperture ovate; columella short, terminating in a twisted plait; lip simple, color violaceous with light colored striæ. Length 1.1, diam. .55 inch [27.9x14 mm.] (*Newc.*).

Molokai: (Newc.); Mapulehu to Halawa (Baldwin); Halawa and Pelekunu (Perkins); Pelekunu, Mapulehu and Halawa, a ground shell (Meyer); all in the eastern end of the island.

Achatinella violacea NEWC., Ann. Lyc. Nat. Hist. of N. Y., vi, May, 1853, p. 18; P. Z. S., Lond., 1853 [1854], p. 135, pl. 22, f. 14.—THWING, Orig. Descriptions, p. 164, pl. 3, f. 23.—PFR., Monogr., iv, 543.—*Amastra v.*, SYKES, Fauna Hawaiiensis, p. 347.—BORCHERDING, Zoologica, xix, p. 105, pl. 10, f. 1.—GULICK, Evolution, Racial and Habitudinal, pl. 1, f. 18.

A. violacea differs constantly from *A. magna* of Lanai by finer sculpture of the embryonic shell, which never shows the peripheral carina above the suture, and in having a thin parietal callus. We do not agree with Borcherding in uniting them specifically.

Fig. 3 represents a specimen in all respects typical, from Halawa, collected by Thaanum. This may be considered type locality. The shell is imperforate. This typical form is well described as violaceous with light striæ, the apex being purplish and the earliest neanic whorls yellowish, interior purple. Sometimes the surface is more worn, and of a nearly uniform flesh tint, the apex nearly white. Small fragments of the thin brown cuticle remain, and when sufficiently preserved on the spire it is seen to have irregular dark figures and lighter ground, showing relationship to *A. nubilosa*. The embryonic

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whorls form a rather acute, conic summit, the first half whorl being smooth, rather coarse, low axial ribs then appearing weakly. The second whorl has rather strong, arcuate ribs, rather wider than their intervals, and split or weak near the lower suture; on the next whorl the ribs are finer, and weak below the middle of the whorl, or split into striæ. There seem to be 3½ embryonic whorls, which in outline are nearly flat.

The following whorls are moderately convex, with sculpture of somewhat thread-like striæ, though in places they are low or partly effaced. The columellar fold is rather small and very oblique. Outer lip thin.

Length 28.3, diam. 15, aperture 13.5 mm.; 7 whorls.

Length 30.5, diam. 13.7, aperture 13 mm.; 7⅓ whorls.

The size varies a good deal. One shell from the Gulick collection measures, length 25, diam. 12.5 mm.; 7 whorls. Another has a spirally lengthened callous ridge upon the parietal wall, revolving into the aperture.

Some of the above-mentioned localities may pertain to the following variety:

69a. Var. *wailauensis* n. v. Pl. 39, figs. 13, 14; pl. 27, figs. 1, 2.

Larger and more robust than *violacea,* the striation weaker; dull gray or fleshy-gray, with shreds of dark brown cuticle chiefly on the last whorl.

Length 38, diam. 19, aperture 16.2 mm.; 8 whorls.

Length 34.6, diam. 18.5, aperture 16.3 mm.; 7½ whorls (no. 104670).

Length 31, diam. 16.5, aperture 14.8 mm.; 7½ whorls.

Length 27, diam. 14.5, aperture 12.8 mm.; 6¾ whorls.

Wailau (Borcherding, Thaanum). Type no. 104670 A. N. S. P.

Borcherding's figures, copied in our pl. 27, figs. 1, 2, represent Wailau examples of this variety. A very large specimen in the Bishop Museum, collected by Mr. Thaanum (pl. 39, fig. 13) has no columellar lamella, probably on account of old age. Two other shells have calluses on the parietal wall such as are mentioned under *violacea.*

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70. A. NUBILOSA (Mighels). Pl. 27, figs. 8, 9, 10, 13.

The shell is imperforate, oblong-conic, moderately strong, lusterless; the apical whorls white, light-brown, or pink, the rest cream-white, covered with a thin cuticle closely figured with fine zigzag or v-like olive-brown marks and narrow streaks, often coalescent behind the outer lip; nude in front of the aperture. Spire a little convexly conic, the penultimate whorl bulging more or less. Second embryonic whorl with sculpture of fine, close, curved striæ; next whorl having the striæ weak except near the suture. Later whorls marked with low growth-wrinkles, stronger near the suture. Penultimate and last whorls strongly convex. Aperture white; outer lip thin and acute, or in large shells, thickened within; columellar lamella strong. Parietal callus thin, white.

Fig. 13. Length 16, diam. 9.5, aperture 8 mm.; whorls 6.

Length 18, diam. 9.5, aperture 8 mm.; whorls 6⅓.

Fig. 9. Length 19, diam. 11, aperture 9.3 mm.; whorls 6⅓.

Fig. 10. Length 22.3, diam. 11, aperture 10 mm.; whorls 7.

"Animal tessellated black and gray (when in motion), tentacles deep black, bottom of foot and mantle dark brown" (*Newcomb*, Ann. Lyc., vi, 312).

Molokai: Kalae, Kaohu, Kahanui and Makolelau, all in the central part of the island (Meyer).

Achatinella nubilosa MIGHELS, Proc. Boston Soc. Nat. Hist., ii, 1845, p. 20.—REEVE, Conch. Icon., vi, pl. 1, f. 1.—GLD., U. S. Expl. Exped., Moll., p. 86, pl. 7, f. 95.—PFR., Monogr., ii, 236; iii, 459; iv, 552; vi. 180; viii, 240.—NEWCOMB, Ann. Lyc. Nat. Hist. of N. Y., vi, p. 312 (living animal).—BALDWIN, Catalogue, p. 9.—THWING, Orig. Descriptions, p. 162, pl. 3, f. 21.—*Amastra nubilosa* Migh., SYKES, Fauna Hawaiiensis, p. 341.—BORCHERDING, Zoologica, xix, 107, pl. 10, figs. 3-5 (1906).

This species is somewhat like *A. assimilis* Newc., of Maui, but it differs by the much finer sculpture of the embryonic whorls. *A. violacea* differs from the Lanaian *A. magna* in the same way. We cannot agree with Borcherding's union of these forms.

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The thin cuticle, marked with zigzag or v-like olive-brown figures on a very pale ground, is characteristic; the variegation being further produced by partial loss of the cuticle. A few specimens, however, such as fig. 8, do not show zigzag markings, but only some inconspicuous mottling, the cuticle being streaked; or on the last half of the last whorl it may be mainly dark, with a few light streaks. In some shells the cuticle is largely lost, as in fig. 13. The locality originally given, "Oahu," was doubtless due to faulty labeling or a mixture of specimens. No mottled *Amastra* occurs on that island. The original description follows:

"*Achatinella nubilosa.* Shell dextral, ovate, conic, thin, variously mottled with dark brown on a light ground, imperforate; whorls 6, convex; aperture semi-circular; lip simple, acute. Length 7, diam. .4 inch. Hab.: Oahu" (*Mighels*).

Two specimens of *nubilosa* received by J. H. Thomson from Mighels, and sold by him to the Portland Society of Natural History (no. 220) are the form described above and similar to pl. 27, fig. 9. They are in poor condition.

Mighels' type was a small example, 17-18 mm. long. Gould figures a much larger, more conic shell, perhaps referable to the following race.

70a. *A. n. macerata* n. subsp. Pl. 27, figs. 5, 6, 7 (11, 12).

The shell is decidedly wider than *nubilosa,* the spire more straightly conic, its whorls (especially the penultimate) less convex; cuticle much lacerated or shredded, the under-tint cream or very pale brownish-cream, apex fleshy or pallid; interior very pale pink, rarely white.

Length 25.5, diam. 14 to 14.7, aperture 12 to 12.5 mm.; 6½ whorls.

Fig. 5. Length 23, diam. 12.8, aperture 11.9 mm.; 6½ whorls (no. 2086).

Fig. 6. Length 20.3, diam. 12, aperture 10 mm. (no. 2086).

Length 25, diam. 13, aperture 11.5 mm.; 7 whorls.

Fig. 7. Length 23.2, diam. 13.5, aperture 11.5 mm.

Molokai: Cotypes no. 105549 A. N. S. P., and 2086 coll. C. M. Cooke; also nos. 2084, 2085 and 2087 Cooke coll.

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Some smaller shells, 21x11 and 19.5x11.8 mm., have a decidedly pink ground-color. They may not be fully adult. Some of the shells figured as *nubilosa* by Borcherding seem to belong to this variety. Two of his figures are copied, fig. 11 from Makolelau, and fig. 12 from Kaohu. This form is somewhat intermediate between *nubilosa* and *violacea.*

Series of A. pullata.

Embryonic shell costate, carinated above the suture (the carina rarely concealed), last whorl covered with a dense dark cuticle; penult. whorl usually streaked, angularly marked or mottled. Rather large species, confined to Molokai, separated from the *assimilis* series by the general appearance, size, and dense, dark cuticle covering the last whorl, rather than by any characters of taxonomic value. It is apparently related to the *nigra* series of Maui, but has no representatives in Lanai.

A single Oahuan shell, *A. tristis,* has much the appearance of the *pullata* group, being similar in shape, covered with a conspicuous blackish cuticle, and having an indistinctly costate, conic embryonic shell; yet other characters cause us to consider it convergent, rather than directly related to *pullata.*

71. A. PULLATA Baldwin. Pl. 27, figs. 14-16.

The shell is obese, oblong with conic spire, thin but strong, of a very pale ochre tint under the cuticle, which is more or less worn from the spire and denuded in a rather large patch in front of the aperture. On the last whorl the cuticle is rather glossy, chocolate-blackish and very dense. On the spire it is copiously streaked with buff, the dark streaks beginning on the fourth whorl. The embryonic shell is flesh-colored, with sculpture of coarse curved ribs (resembling *aurostoma,* pl. 26, fig. 11, except that the peripheral carina is less prominent, from being more covered by the following whorl). Subsequent whorls are convex, with moderate growth-wrinkles. The aperture is pure white within. Outer lip thin-edged, sometimes strengthened by a narrow and low internal rib. Columellar lamella thin, steeply descending, abruptly truncate at the end.

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Fig. 14. Length 22.8, diam. 13, aperture 11 mm.; 6¾ whorls.

Fig. 15. Length 22, diam. 12.1, aperture 11 mm.; 6¾ whorls.

Fig. 16. Length 22.5, diam. 13.5 mm.

Molokai: Waikolu (type loc.); Kaohu, Kahanui and Waiakapuaa (Borcherding); all in the northern half of the island, south and southeast of the northern peninsula; Kamalo and Makakupaia Mts. (Perkins).

Amastra pullata BALDW., Proc. A. N. S., Phila., 1895, p. 228, pl. 11, figs. 31, 323 (shell).—GWATKIN, t. c., p. 239 (radula).—BORCHERDING, Zoologica, xix, p. 109, pl. 10, figs. 6, 7, 8.

"Animal extended in motion a trifle longer than the shell. Mantle almost white with a slate tinge. Foot above and below almost white, the posterior portion and edges densely studded with very minute pink spots. Tentacle short, light slate, with a few spots of the same color on the head above. Unlike most of the Amastra, which generally have dark, dingy colored animals, this species has a beautiful, almost white animal. The after portion and edges of the foot under a lens are seen to be closely studded with minute pink spots which give these parts a delicate pink hue" (*Baldwin*).

Distinguished from *A. umbrosa* by the more strongly sculptured apex. The color of the animal seems also to be characteristic. Described from the type. In one of five specimens of the original lot sent by Mr. Baldwin the interior is a delicate shade of pink. In the others it is white or blue-white.

The embryo resembles pl. 26, fig. 5 except that the spire is lower and the ribs coarser. They begin on the second half of the first whorl, are strong and coarse to the end of the second whorl, after which they became closer and weaker. The peripheral keel projects very narrowly on the second whorl and is marked on the last with a white band. The completed embryo has 2½ whorls and is imperforate.

A common form in the C. M. Cooke and other collections studied is decidedly more obese, with larger aperture, apex white or flesh-colored. The cuticle is slightly mottled with dark on the penultimate whorl, the last whorl colored as in *pullata* (pl. 37, fig. 17).

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Length 21.5, diam. 14, aperture 11.9 mm.; 6½ whorls.

Length 21.9, diam. 13.5, aperture 11.6 mm.; 6½ whorls.

Other specimens are ochraceous, with small shreds of the dark outer cuticle (pl. 37, fig. 21).

71a. Var. *subnigra* n. v., pl. 27, figs. 19, 20, 21.

Similar to the preceding but smaller, the upper part of the spire is purplish-brown; under-cuticle orange or pale yellow under the more or less deciduous blackish layer. Shape variable.

Fig. 19. Length 18.5, diam. 10.9, aperture 9.1 mm.; whorls 6½.

Fig. 21. Length 18, diam. 11, aperture 10 mm.; whorls 6. Length 20.3, diam. 11, aperture 9.6 mm.; whorls 6½ (cotype).

Length 19.3, diam. 11, aperture 9.5 mm. (cotype).

Molokai: Cotypes 2095 Cooke coll., and 105516 A. N. S. P.

71b. *A. p. umbrosa* Baldwin. Pl. 37, figs. 14, 15, 16.

The shell is globose-conic, moderately solid, imperforate, soiled or isabella-white, covered with an olivaceous-brown, black streaked, slightly glossy cuticle, which is irregularly streaked with whitish and marked with some triangular spots, or on the last half of the last whorl is sometimes nearly continuous; the denuded apex being red-brown or dark purple. Spire straightly conic, the whorls but very slightly convex. Embryonic whorls flat, conic, the first half-whorl smooth, next half-whorl coarsely but rather weakly plicate, but showing no supersutural keel, following whorl finely plicatulate. Later whorls are marked with growth-wrinkles; the last whorl has more or less malleation in a spiral direction, is inflated, and descends a little in front. The aperture is white within, outer lip thickened within the acute edge. Columella white, calloused, bearing a stout, subhorizontal lamella below the middle. Parietal callus very thin.

Length 19.5, diam. 12.9, aperture 10 mm.; 5¾ whorls.

Length 21, diam. 12.5, aperture 10.2 mm.; 6 whorls.

"Animal extended in motion longer than the shell. Mantle dark brown with a margin of lighter shade. Foot light brown, the superior portion and sides studded with large

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spots of deeper shade. Tentacles short, stout, very dark brown " (*Baldwin*).

" The formula of dentition is 28.1.28. The marginals take a peculiar form " (*Gwatkin*).

Molokai: Kamelo (Baldwin); Makolelau and Waiakapuaa (Meyer).

Amastra umbrosa BALDWIN, Proc. A. N. S., Phila., 1895, p. 229, pl. 11, figs. 36, 37.—BORCHERDING, Zoologica, xix, p. 111, pl. 10, figs. 9, 10.—*Achatinella umbrosa* THWING, Orig. Descriptions, etc., p. 163, pl. 3, f. 22.

This form is closely related to *A. pullata* (with which Sykes unites it as a local form), but the embryonic shell, especially the second whorl, is less strongly plicate in *umbrosa*, and does not show the keel above the suture; the adult is more inflated than typical *pullata*, but not more than the obese variety; finally, the color of the animal is different. It seems to be a local race of *pullata*. Borcherding affirms the presence of transitional examples in his series, collected by Meyer, but we are not sure that he had the real *umbrosa*. Figured from the type lot, no. 65714, A. N. S. P.

72. A. SEMINUDA Baldwin. Pl. 37, figs. 18, 19, 20.

The shell is imperforate (or sometimes rimate), globose-ovate, solid, yellow, covered with a thin cuticle which on the spire, the front and upper half of the last whorl is yellow with sparse chocolate mottling or streaking, and on the lower half of the last whorl is in large part black. The embryonic whorls are denuded of cuticle, and either white, fleshy or purplish (and sometimes the whole spire is of a dull purplish color). Embryonic shell of about 2½ whorls, the first half-whorl smooth, next whorl coarsely costate, with a barely exposed basal carina, the following whorl more closely costate. Later whorls are rather rudely wrinkle-striate, with on the last whorl some weak spirals cutting the wrinkles, and more or less malleation. Last whorl globose (or sometimes compressed), often obscurely angular above the aperture. Aperture oblique, white, well-rounded below. Outer lip slightly or heavily thickened within; columellar lamella strong, median. Parietal callus very thin.

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Length 16, diam. 9.3, aperture 7.9 mm.; 6 whorls.
Length 15.1, diam. 10.1, aperture 8.9 mm.; 5⅓ whorls.
Length 15, diam. 10, aperture 8.9 mm.
Molokai: Waikalu.

Amastra seminuda BALDWIN, Nautilus xix, April, 1906, p. 137.

Smaller than the very closely related *A. pullata*, more rudely sculptured, the last whorl light-colored above, dark below the middle, the division of color generally abrupt. The description and figures are from the type lot in the Baldwin collection.

73. A. UNIPLICATA Hartman. Pl. 28, figs. 17, 18, 21, 22; pl. 49, fig. 12.

" Shell dextral, solid, elongate oval, occasionally cylindrical, whorls 7, slightly rounded, the last somewhat inflated, suture impressed, longitudinally striate, aperture sub-oval, white; a single white elongate twisted plica within; outer lip acute, color of the shell a pale ochre-yellow, concealed by a black epidermis. Length 20, diam. 9, aperture 28, diam. 4 mm.

" This shell is from a different island from *A. biplicata* Newc., which it resembles; the latter possesses more coarse longitudinal striæ, and has a double plica within, and the aperture is red, while *uniplicata* has a single plica, and the aperture is white " (*Hartman*).

Molokai (Hartman from Pease coll.): Kamalo (Baldwin, Meyer).

Amastra uniplicata HARTMAN, Proc. A. N. S., Phila., 1888, p. 50, pl. 1, f. 7.—BALDWIN, Catalogue, 1893, p. 10.—BORCHERDING, Zoologica, xix, p. 112, pl. 10, f. 11.

Typical specimens, received from Hartman, are figured, pl. 28, figs. 21, 22. The shell is pale yellow under a thin, partly deciduous cuticle, which is black or dark chestnut on the last whorl, and yellow, with or without dark markings, on the penultimate whorl. The embryonic whorls are flat, flesh-tinted; initial half-whorl is smooth, next whorl strongly costate with a basal carina, following whorl much more finely

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costulate. The later whorls have weak growth-striæ. Length 20, diam. 10.9, aperture 9.2 mm.; 7 whorls.

In a longer specimen, pl. 49, fig. 12, the first 3½ whorls are brown, dark red-brown at apex; next two whorls white, lightning-marked with zigzag black stripes; last 1¼ whorls covered with a dense black cuticle, worn off in front of the aperture, exposing a white patch. The penultimate whorl is convex, those above it only very slightly so, the last whorl being somewhat compressed in the middle. Aperture white; axis perforated. Length 21.9, diam. 10.9, aperture 8.3 mm.; 7 whorls (no. 104684, A. N. S. P.).

A. nubilosa, a species resembling *uniplicata* in shape and size, differs by characters of the embryonic whorls.

A. uniplicata is closely related to *A. pullata,* from which it differs chiefly by its much narrower contour. It is not allied to *A. biplicata* as Hartman supposed.

Series of A. assimilis.

The Molokaian Amastræ having zigzag or angular markings are a most intricately related group of forms, which can only be understood when large collections are made and the distribution of the several forms adequately mapped. At present we know of them scarcely anything of value to science; merely that the series is developed in a rich variety of forms in eastern Molokai, that these races vary widely in ground-color and markings, and that some of them show close affinity with races of Maui. Most of the species and subspecies which have been established are merely tentative.

Through *A. borcherdingi* and *uniplicata* this group connects with the *pullata* series.

✓ 74. A. BORCHERDINGI Hyatt & Pilsbry, n. sp. Pl. 41, figs. 1, 2, 3, 4; pl. 40, figs. 2-6.

The shell is ovate-conic, narrowly perforate or closed, moderately strong; upper 3 or 4 whorls reddish-brown (rarely pale yellow), the last two white with a faint flesh tint, elaborately figured with angular, zigzag or interrupted dark

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brown figures, on the last half-whorl becoming chestnut with darker streaks; this cuticle wanting in front of the aperture, more or less deciduous elsewhere, and frequently almost wholly lost in adult shells. The flat whorls of the conic embryonic shell are costate and the second one shows a keel close above the suture. Subsequent whorls have rather fine, irregular growth-lines, and the last whorl sometimes shows some obliquely-descending facets or malleation. The aperture is nearly white within, and the lip a little thickened towards and at the base. Columellar lamella rather small and oblique.

Length 17.3, diam. 10, aperture 9 mm.; 6⅓ whorls.

Length 17, diam. 9.8, aperture 8.5 mm.; 6⅓ whorls.

Length 19, diam. 10.5, aperture 9 mm.; 6½ whorls.

Molokai (Gulick, Meyer). Cotypes 104688, 57714, A. N. S. P., 13446, Boston Soc.

Amastra mucronata Newc., BORCHERDING, Zoologica, xix, Heft 48, 1906, p. 119, pl. 10, f. 17 (Kalae). Not of Newcomb.—*Amastra mastersi* Newc., BORCHERDING, t. c., p. 116, pl. 10, figs. 16, 18. Not of Newcomb.

The shell is more capacious than *A. mucronata* or *A. similaris*, with a larger aperture. The precise locality of the types is unknown, but Borcherding has figured the same form from Kalae (copied in pl. 40, figs. 5, 6) and from Kawela (pl. 40, figs. 2-4), under the names *A. mucronata* and *A. mastersi*. He states that the long series examined indicates a transition between the two forms, " the ornamental marking of typical *mucronata* disappearing gradually and passing into a more uniform epidermis."

Three examples in the Cooke collection, pl. 37, figs. 10, 11, 12, have the zigzag pattern of the cuticle more confused, in one example, fig. 10, it is almost wanting. These shells are probably the same as what Borcherding has figured as *A. mastersi*.

This species is very closely related to the west Mauian *A. assimilis*. It is decidedly more remote from *A. mastersi*. In Molokai it may also claim kinship with *A. uniplicata*.

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75. A. MUCRONATA (Newcomb). Pl. 40, fig. 9.

Shell dextral, elongate-ovate, white with numerous transverse, arrow-headed brown markings except last whorl which is covered with a dense brownish-black epidermis; whorls 6, rounded, the last contracted; suture slightly impressed in the upper portion, becoming deep at the junction of the last whorl. Aperture small, ovate; columella with a twisted plait; lip simple. Length .7, diam. .32 inch [17.5x8 mm.] (*Newc.*).

Molokai (Newcomb, Baldwin).

Achatinella mucronata NEWCOMB, Annals of the Lyceum of N. H. of N. Y., vi, 1853, p. 28; Proc. Zool. Soc. Lond., 1853, p. 146, pl. 23, fig. 49.—PFR., Monogr., iv, 553.—*Amastra mucronata* Nc., PEASE, P. Z. S., 1869, p. 650.—SYKES, Fauna Hawaiiensis, p. 340.—BORCHERDING, Zoologica, xix, p. 118, not pl. 10, f. 17.—*A. mueronata* Newc., HARTMAN, Proc. A. N. S., Phila., 1888, p. 47.—*Achatinella fusiformis* PFR., P. Z. S., 1855, p. 5, pl. 30, f. 18; Monogr., iv, 550.

Pl. 40, fig. 9 is copied from Newcomb's type figure of *A. mucronata.*

The description of *A. fusiformis* (which Baldwin, Sykes and Borcherding agree is an absolute synonym of *mucronata*) follows. It is a smaller shell than typical *mucronata. A. fusiformis* Pfr. (pl. 40, fig. 10, copied from Pfr.). "Shell imperforate, fusiform-oblong, rather thin, striatulate, deep brown, mottled and obliquely lineolate with a pale tint. Spire convexly-conic, apex black, acute; suture simple; whorls 7, slightly convex, the last forming two-fifths of the total length, tapering at base. Aperture oblique, ellipsoidal; the columellar fold small, compressed, obscurely doubled; peristome simple, unexpanded, the right margin regularly arched, columellar margin narrowly adnate. Length 14, diam. 6⅔, aperture 6 mm. long, 3 wide." Sandwich Islands, Frick. (*Pfr.*)

In his article in the P. Z. S., Newcomb gives the locality for *mucronata* as Maui—possibly an error, as he has stated that he did not see proofs of that article. It must be noted, however, that some very similarly marked shells occurring at Wailuku, West Maui, have been identified by Gulick as *A. mucronata.* The shells figured by Borcherding are certainly

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not *mucronata,* being larger with a larger aperture. See *A. borcherdingi.* So far as we know the typical form of the species as figured by Newcomb is not specifically different from the shell commonly known as *simularis* Hartman. Hartman notes the resemblance of his species to *A. mucronata,* but does not mention the differences upon which *simularis* was based. The description follows:

Amastra simularis. "Shell dextral, ovate-conic, whorls 5½, slightly rounded, body-whorl somewhat inflated, two-thirds the length, the first 1½ composed of slightly curved plicæ, suture lightly impressed, epidermis dark brown with black zigzagged lines and linear striæ, body-whorl a dark red color beneath the epidermis; aperture semi-ovate, dark red, columella straight, with a white twisted plait near the base. Length 15, width 7, aperture 6x3 mm. Molokai. Received from D. B. Baldwin, Esq., and so called from its size and resemblance to *A. mucronata* Newc." (*Hartman.*)

Amastra simularis HARTMAN, Proc. A. N. S., Phila., Oct. 23, 1888, p. 252, pl. 13, f. 7.—GWATKIN, Proc. A. N. S., Phila., 1895, p. 239 (radula).—ANCEY, Proc. Malac. Soc., Lond., iii, 1899, p. 269.—SYKES, Fauna Hawaiiensis, p. 343.—BORCHERDING, Zoologica, xix, Heft. 48II, p. 112, pl. 10, f. 12.

As stated above, this is specifically identical with *mucronata,* from which it differs only in the dark ground-color; but in several large lots examined there are shells with pale and even almost white ground, so that the retention of *simularis* as a varietal term for the dark form is of doubtful utility.

Figures 1 to 5 of plate 28 represent specimens of the original lot of *simularis* obtained by Mr. Baldwin, who supplied Hartman's type. Fig. 6, copied from Borcherding, represents a Halawa shell. A fuller description follows.

The shell is imperforate, oblong-conic, rather solid, *glossy,* of a *red-chestnut color,* or sometimes pale fleshy-yellow or almost white on the last whorl or two; the penultimate whorl and first half of the last copiously marked with *zigzag black or chocolate lines,* the last half of the last whorl nearly uniform chocolate or blackish. Embryonic sculpture about as in

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A. uniplicata, etc., coarse ribs on the first, finer on the second whorl, which shows the carina at the suture, then the riblets shorten, persisting longest below the suture; the later whorls but slightly convex, marked with faint growth-wrinkles, and subplicate below the suture. Aperture small, violet, livid red or blue-white within. Outer lip hardly thickened; columellar lamella small, median.

Length 17, diam. 9, aperture 7.8 mm.; 6½ whorls.

Length 17, diam. 9.2, aperture 8 mm.

Molokai: Mapulehu (Baldwin): Halawa and Moakea (Borcherding).

Some examples have none of the blackish outer cuticle, the whole shell being reddish, with a yellow sutural border, purple-black apex and inconspicuous traces of dull outer cuticle, also reddish, on the last whorl. A very dark specimen in the Cooke collection has some flecks of whitish, hydrophanous cuticle on the last whorl, between the black stripes.

A. simularis var. *maura* Ancey (pl. 28, fig. 14), is not distinct from the typical form of *simularis* judging from a cotype which I owe to the courtesy of the Bishop Museum. The original figure is copied, and the description follows: " Shell much larger and more obese than the type (length 17, width 9, apert. 7 mm.), with 6 whorls. Color dark red, blackish at the apex; periostracum black, decorticated at some places; columellar margin very dark with a whitish fold; interior of aperture dark purple-red " (*Ancey*).

Amastra simularis var. *maura* Ancey, Proc. Malac. Soc., Lond., iii, 1899, p. 270, pl. 13, f. 16.—Borcherding, Zoologica, p. 114, pl. 10, f. 14 (Halawa, Molokai).

75a. *A. m. roseotincta* Sykes. Pl. 28, figs. 11, 12, 15.

" Differs from the type in being of a very much lighter shade, the apex, however, being of the usual dusky tint; the shell is also more ovate and shorter and the lamina is slightly more horizontal. Molokai mountains " (*Sykes*).

Amastra simularis Hartman var. *roseotincta* Sykes, Proc. Malac. Soc., Lond., ii, p. 130, October, 1896; Fauna Hawaiiensis, p. 344, pl. 11, f. 3.—? Borcherding, Zoologica, p. 113, pl. 10, f. 13 (Moakea, Molokai).

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Mr. Sykes' figure is copied (fig. 15), and two other specimens from the Cooke collection are figured. Fig. 11 represents a roseate shell with dark summit and very small remains of a brown cuticle on the last whorl. Fig. 12 is a lilac-gray shell with yellow upper whorls, and also mere traces of cuticle.

75b. *A. m. citrea* Sykes. Pl. 28, figs. 16, 7 to 10.

"Shell dextral, imperforate, ovate-fusiform, rather solid, a little glossy, yellow; somewhat obliquely, strongly striate, Apex resinous, rather acute. Whorls 6, plano-convex, the first moderately plicate, the last two-thirds the length of the shell, slightly covered with a black-brown cuticle; suture impressed. Aperture ovate-lunate; columella twisted, with a strong white lamina; peristome simple, the right margin unexpanded, acute. Length 15, diam. 8 mm" (*Sykes*).

Molokai (Hutchison, Baldwin); Moakea, at the eastern end of the island (Borcherding).

Amastra citrea Sykes, Proc. Malac. Soc., Lond., ii, Oct., 1896, p. 129; Fauna Hawaiiensis, p. 335, pl. 11, f. 5.—Borcherding, Zoologica, xix, p. 114, pl. 10, f. 20.

This form is usually smaller and a little more widely conic than *A. simularis,* but it is chiefly distinguished by the pale yellow ground-color. The shapes intergrade; and there are specimens intermediate in color between *citrea* and *roseotincta.* Typically, only traces of the outer cuticle remain (as in fig. 16, copied from Sykes, and fig. 10, Cooke coll.), the apex being whitish at the tip in some, dark brown in other individuals; or there may be a brown cuticle in oblique, angular lines, becoming nearly uniform behind the lip, as in the typical form of *simularis* (pl. 28, figs. 7, 8, 9). The size varies in specimens apparently adult.

Fig. 7. Length 16.2, diam. 8.4, aperture 8 mm.; 6⅓ whorls.
Fig. 8. Length 13.5, diam. 7, aperture 6.2 mm.; 6⅓ whorls.
Fig. 9. Length 11.6, diam. 6 mm.; 5¾ whorls.
Fig. 10. Length 13, diam. 7.8 mm.; 6 whorls.

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75c. *A. m. atroflava* n. subsp. Pl. 41, figs. 9-13; pl. 40, figs. 13, 14.

Imperforate, ovate, thin but rather strong, slightly shining; outlines of the spire nearly straight; embryonic whorls white or pale, very strongly costate and carinate (pl. 41, fig. 10). Following whorls irregularly wrinkle-striate, the last whorl usually malleated below the periphery. Neanic and last whorls covered with a glossy yellow cuticle, and a very thin, yellow outer cuticle wanting in front of the aperture, and figured with angular black or umber markings which generally coalesce to form a black area on the lower half of the last whorl. Aperture white, with the weak trace of a lip-rib.

Length 17, diam. 8.7, aperture 8 mm.; 6⅓ whorls.

Length 14.8, diam. 8, aperture 7 mm.; 6⅓ whorls.

Molokai: Kawela (figs. 13, 14) and Kamalo (Borcherding. Cotypes no. 105518, A. N. S. P., and no. 1813 coll. University of Wisconsin.

Amastra modesta BORCHERDING, Zoologica, xix, Heft. 48, p. 120 (in part), pl. 10, f. 19.

The main color-patterns are shown in pl. 41, figs. 9-13, cotypes, and pl. 40, figs. 13, 14, copied from Borcherding, who considers *A. rustica* Gul. a synonym. It is certainly very close to *rustica,* differing in the brighter yellow color and the more prominent keel on the second whorl; but the rather wide separation of the localities—*rustica* having been found only in East Maui—gives reason to think them homoplastic or convergent forms ultimately derived from the same stock, rather than directly connected. It must be freely admitted that "species" in the *affinis-assimilis* group are more than usually conventional. A survey of the region, with a thorough study of the local races must be made before any serious attempt at classification will be possible. *A. m. atroflava* differs from *A. m. citrea* Sykes by somewhat stronger striation, coarser embryonic sculpture and generally wider contour; yet it may perhaps prove to be a form of that.

75d. *A. m. semicarnea* Ancey. Pl. 28, fig. 13; pl. 39, fig. 16.

"Shell larger than the type, but more slender than var.

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maura (length 16.5, width 8.5, apert. 6 mm.), with 6 whorls. Apex blackish, the subsequent whorls fulvous, sometimes with straight, somewhat obscured, revolving lines, the lower half of the last whorl yellowish flesh-colored. Columellar margin bluish, with a white plait. Mouth light-colored " (*Ancey*).

Amastra simularis var. *semicarnea* ANC., l. c., pl. 13, f. 8.—Not BORCHERDING, l. c., p. 114, pl. 10, f. 15.

A cotype from Ancey's collection, no. 18345, Bishop Museum, is figured on pl. 39. The first 1½ whorls are flattened, strongly costate and carinate, as in typical *mucronata* (*simularis*). Subsequent whorls have the color of *A. mastersi;* and no doubt this form is what Newcomb referred to as *mastersi* from Molokai in his Synopsis, p. 149, as Dr. Cooke has suggested to me. It differs from the true *mastersi* by the less inflated shape and the very strong sculpture of the early whorls. Length 16, diam. 8.8 mm. Borcherding's figures represent a rather obese form of " *simularis* ".

76. A. SYKESI n. sp. Pl. 42, figs. 2, 3.

The shell is subrimate, *globose-conic,* thin, not shining. After the smooth initial half-whorl there is a flat, strongly costate whorl, with a carina half-concealed in the suture; the next whorl is costulate only below the suture, its lower part smooth. Following whorls but weakly convex, finely marked with growth-wrinkles which are a little stronger on the globose last whorl. The entire shell may be fleshy-ochraceous, with some faint angular brown markings on the penult. whorl, the last whorl without outer cuticle; or it may be very faintly yellow-tinted white, the apex brownish, last two whorls partly covered with an extremely thin cuticle which is marked with zigzag olive-brown streaks. Aperture pinkish in the one, white in the other color-form; outer lip narrowly rimmed within. Columellar lamella triangularly projecting.

Length 11.1, diam. 7.5, aperture 6 mm.; 5½ whorls.

Length 10.8, diam. 7, aperture 6 mm.; 5½ whorls.

Molokai: Halawa (D. Thaanum). Cotypes to be deposited in Bishop Museum, from no. 5316, Thaanum coll.

Very much more inflated than any other zigzag-striped

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species of Molokai or Maui, but otherwise related to *A. mucronata* and *atroflava*. *A. nucula* Smith differs by its very much more finely striate second embryonic whorl, and less importantly by the more solid texture and malleated surface. Moreover, in the type of *nucula* the cuticle is preserved except in front of the aperture, and it shows no color markings of any kind. Named for E. R. Sykes, author of the molluscan part of *Fauna Hawaiiensis*, and other useful works.

77. A. NUBIFERA n. sp. Pl. 41, figs. 6, 7.

Shell subperforate or imperforate, ovate-conic, rather thin, scarcely shining. Outlines of the spire straight. First half-whorl smoothish, next whorl rather weakly but coarsely costate, the ribs low, a keel indistinctly showing very close above the suture; succeeding whorl very finely costulate. Following whorls weakly convex, with fine sculpture of growth-wrinkles. Under the cuticle the shell is pale reddish-brown above the periphery, the first three whorls dark purple-brown; base white. Cuticle thin and smooth, in front pale with olivaceous angular or dislocated stripes, on the back of the last whorl olivaceous with darker longitudinal streaks and some light and dark mottling. Aperture bluish or fleshy-white within lip thin and sharp; columellar lamella moderate, strongly oblique. Length 12.5, diam. 7.3, aperture 6.1 mm.; 5½ whorls.

Molokai: Cotypes no. 2048, C. M. Cooke coll.

This species differs from *A. subobscura* by broader contour at all stages of growth, and by the coloration, *subobscura* having no cuticular maculation. It is a broader, thinner shell than *dissimiliceps*, which is closely related. The *mastersi* type of ground-color this species shares with *A. m. semicarnea*, some forms of *A. affinis*, and other species. There are two shells in the Cooke collection, one in coll. Boston Society.

There is also in the Boston collection, no. 13468, a somewhat smaller form, length 12, diam. 6.8 mm., in which the undercolor of the last two whorls is white and the apical costation is stronger. This may perhaps prove distinct.

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77a. A. N. DISSIMILICEPS n. subsp. Pl. 28, figs. 19, 20.

Shell oblong, similar to *A. mucronata* in size and general shape, but the long spire has more convex outlines. Embryonic whorls purple-brown, convex, with somewhat finer sculpture than *A.* (*simularis*) *mucronata* and not showing the keel above the suture. Ground-color of the later whorls cream or slightly flesh-tinted; cuticle entire on the last half-whorl, brown with black streaks; on the preceding 1½ or 2 whorls it is largely deciduous, but where retained it forms a rather coarse, irregular tracery, similar to some examples of *A. uniplicata,* and unlike the angular striping of *A. mucronata.* Aperture pink within (fig. 20) or blue-white (fig. 19). 6½ whorls.

Fig. 20. Length 17.5, diam. 8.2, aperture 7.3 mm. (type).

Fig. 19. Length 16.3, diam. 8, aperture 7 mm.

Molokai: Type no. 2047, coll. C. M. Cooke.

A longer, more solid shell than *A. nubifera,* but like that in the color, shape and sculpture of the embryonic whorls.

78. A. MODESTA (C. B. Adams).

" Shell rather thick and short, ovate-conic; dingy reddish or ash brown; more or less covered with a dingy dark-brown epidermis; with fine irregular transverse striæ, which are coarser on the upper whorls; without spiral striæ; apex subacute; spire short, with the outlines quite curvilinear; whorls six, moderately convex, with a well impressed suture; last whorl rather ventricose; aperture ovate, somewhat acute above; lip sharp, not expanded, moderately thickened within; columellar fold well developed, quite opaque. Mean divergence 50 degrees. Length .54, breadth .3, length of aperture .26 inch." [=length 13.5, diam. 7.5, aperture 6.5 mm.] (*Ad.*)

Sandwich Islands (Adams).

Achatinella modesta C. B. AD., Ann. Lyc. N. H. of N. Y., v, p. 44; Contrib. to Conch., no. 8, p. 128 (Oct. 21st, 1850).—PFR., Monogr., iii, p. 457.—BALDWIN, Catalogue, p. 9 (Molokai).

The type of *A. modesta* has not been figured, and its recog-

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nition as a Molokaian species is at present hypothetical. Borcherding has figured a form from Kawela which closely resembles the East Mauian *rustica* Gulick. It seems to differ from Adams's description of *modesta* in color and shape of the spire.

78a. A. M. DIMISSA n. subsp. Pl. 40, figs. 11, 12.

Some specimens received from Gulick as *A. modesta* are larger, the last two whorls cream-white, earlier whorls fleshy-brown; the last whorl is covered with a thin olive-brown cuticle with pale streaks. The dull surface is unlike *A. simularis*. These shells have no zigzag lineolation, but the cuticle is slightly mottled in places. The lip has a narrow white thickening within; the vertical, blue columella bears a very oblique fold. Embryonic whorls costate and carinate.

Fig. 11. Length 17, diam. 8.9, aperture 8 mm.; 6½ whorls.

Fig. 12. Length 16.5, diam. 8, aperture 7.1 mm.

Molokai: Cotypes 92683 and 10209, A. N. S. P., from the Gulick collection. Temporarily grouped under *modesta*. It is very unlike *atroflava*.

79. A. SUBOBSCURA Hyatt & Pilsbry, n. sp. Pl. 42, fig. 6.

The shell is minutely perforate, oblong-conic, rather thin, slightly shining. Outlines of the spire are nearly straight; embryonic whorls reddish-brown; after a smooth half-whorl there is a coarsely costate whorl, carinated close above the suture; the next whorl is finely and very closely costulate, and subangular next the lower suture. Following whorls convex, sculptured with growth-wrinkles, subplicate just below the suture, pale fleshy-gray, partly covered with a very thin, smooth olivaceous cuticle, darkest on the last half-whorl, wanting in front of the aperture. Aperture pinkish-white, the outer lip not thickened. Parietal callus whitish, rather thick. Length 11.9, diam. 6, aperture 5.1 mm.; 6 whorls.

Molokai: Ulapue. Type to be deposited in Bishop Museum, collected by D. Thaanum.

Well distinguished by its plain cuticle, without mottling or markings of any kind. *A. amicta Smith* differs by the

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roughness of the epidermis; its embryonic sculpture is unknown. *A. subobscura* resembles *dimissa* in miniature.

Three specimens, no. 13447, Boston Society, also belong to this species, and were studied by the senior author and the present writer. The ground-color is pale yellow with olivaceous cuticle, fleshy-yellowish, and fleshy-brown with chestnut cuticle. The parietal callus is very thin.

Series of A. pusilla.

Two Molokaian species seem to belong with the Lanaian *A. pusilla.* They are banded or banded and streaked, but without angular zigzag markings or mottling.

80. A. TRICINCTA n. sp. Pl. 39, fig. 15.

Shell perforate, ovate-conic, very small, thin, a little shining. Outlines of the spire nearly straight. Embryonic whorls somewhat convex, the first half nearly smooth, carinate close above the suture, the next whorl very finely costulate or sharply striate, subangular close above the suture. Following whorls moderately convex, marked with fine, irregular growth-wrinkles. Last whorl rounded peripherally. Dark brown, the last whorl having opaque white revolving bands at the suture, periphery and around the umbilical slit, and several narrow, obliquely longitudinal, black streaks; upper whorls reddish-brown. Aperture dark within, showing a median white band. Outer lip thin, acute. Columella dark, bearing a rather thin, strongly oblique lamella. Length 8.8, diam. 5, aperture 4.3 mm.; 5 whorls.

Molokai: Kolekole. Type to be deposited in Bishop Museum, collected by Mr. D. Thaanum.

About the size of *A. petricola,* from which it differs in characters of the embryonic whorls and in coloration. A very distinct species.

81. A. ELEGANTULA n. sp. Pl. 40, fig. 15.

The shell is imperforate, small and rather thin, ovate with straightly conic spire. The last whorl is very pale brown, lighter at the suture, with an opaque white band at the periphery, and sparsely streaked with brown, becoming chestnut-

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brown behind the lip. Embryonic whorls slightly convex, the first very finely striate, the second finely plicatulate below the suture, becoming striate in the middle; following whorls sculptured with growth-striæ. Outer lip thin. Columella purplish, bearing a rather strong, thin lamella.

Length 11.8, diam. 6.9, aperture 6 mm.; whorls 5½.

Molokai: Type 2050, C. M. Cooke coll.

This species resembles *A. petricola* by having an opaque white band, but it differs in shape, etc. The sculpture of the second whorl is coarser than in *petricola*. It is a broader shell than *A. tricincta*, which is rather closely related. In general shape the shell is not unlike *A. rustica* Gulick. The type, and another specimen in Cooke coll., are probably not fully adult. Borcherding's pl. 10, fig. 22, from Kamalo may be this species. It does not seem to be *A. petricola*.

Section HETERAMASTRA Pilsbry (p. 283).

82. A. PERVERSA n. sp. Pl. 49, fig. 5.

Shell sinistral, oblong-turrite, rather solid. Spire a trifle contracted near the summit. Embryonic whorls delicately costulate as in *A. læva;* following whorls having subobsolete growth-wrinkles, less developed than in *A. læva*. Aperture small, somewhat thickened within. Columellar lamella receding, small and oblique. Length 11.5, diam. 5.5, aperture 4.3 mm.; 6½ whorls.

Molokai: Halawa, near the eastern end of the island, fossil (D. Thaanum). Type in Bishop Museum.

This shell is very closely related to *A. læva* of East Maui, differing only in being smoother and in having whorls of slightly smaller caliber—about one more in shells of equal length; the aperture therefore smaller. Whether these distinctions will hold in further specimens remains to be seen. Only one example, collected by Mr. D. Thaanum, has been examined. The dilated columellar margin is broken in the figured type.

00. A. HUTCHINSONII Pease. Pl. 49, figs. 3. 4.

See species no. 89.

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AMASTRÆ OF MAUI.

The Amastræ of Maui are in the main smaller than those of Molokai and Lanai, the *magna* and *biplicata* series being absent here, while globose *Cyclamastræ*, wanting in the other two islands, are present. Otherwise the species are closely related to those of Molokai, and in some cases hardly separable.

The Amastræ of the eastern and western mountain masses of Maui are specifically distinct but so closely related that we have reason to believe that the present isolation by a treeless, grassy area has been effected in Pleistocene time. The two areas apparently existed as a continuous forested tract up to and probably for a short time after the separation from Molokai.

The island is therefore by no means so fundamentally dual as Oahu, where distinct groups of Amastræ were evolved on the two areas.

Luxuriant native forests occupy the higher part of West Maui and they are especially extensive on the windward (northeastern) slopes of Haleakala, East Maui, where many new forms will doubtless be found, for this almost impenetrable forest remains unexplored and its molluscan life is unknown, as Baldwin writes. On the western slope of Haleakala, in Kula, where most of the Newcomb and Gulick species, and the specimens in the older collections were taken, the forests are in large part dead or dying.

Key to Amastræ of Maui.

I. Shell sinistral (see *Heteramastra*, p. 283).

II. Shell dextral.

a. Shell umbilicate (*Cyclamastra*).

b. Globose-conic, diam. about two-thirds the length or more.

c. Periphery rounded. *A. obesa*, no. 84.

*c*¹. Periphery angular. *A. agglutinans*, no. 85.

*b*¹. Ovate-conic, diam. not much over half of the length. *A. morticina*, no. 83.

*a*¹. Shell imperforate or nearly so (*Amastra*).

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b. Last whorl pale or creamy under a plain blackish cuticle.

c. Globose-conic, or acutely ovate, diam. more than half the length.

d. Larger, length 19 to 23 mm., spire broadly conic; W. Maui.
A. baldwiniana, no. 91.

*d*¹. Smaller, length 15 to 17 mm., spire concavely conic; E. Maui. *A. nigra,* no. 92.

*d*². Smaller, more solid; length 12.5 mm.
A. subcrassilabris, no. 93.

*c*¹. Oblong-conic, diam. about half the length; 20x10 mm. *A. makawaoensis*, no. 94.

*b*¹. Glossy, with no dark outer cuticle; chestnut or chestnut and yellow, not malleated; 18 to 20x10 mm. *A. mastersi,* no. 95.

*b*². Straw-colored or brownish, covered with a thin epidermis, the apex purple; 15x7.5 mm.
A. erecta, no. 101.

*d*³. Dark reddish-brown, with some dusky cuticle on last whorl; 11.3x6 mm. *A. johnsoni,* no. 100.

*d*⁴. Dark brown, plain or banded with white; no dull outer cuticle; 11x6.3 mm.
A. a. subpulla, no. 96d.

*b*⁵. Later whorls with mottled or zigzag-marked cuticle.

c. Last whorl angular at periphery; 15 to 16.5x 9.5 mm. *A. conifera,* no. 99.

*c*¹. Last whorl rounded. *A. affinis,* no. 96; *malleata,* no. 98; *nana,* no. 97; *assimilis,* no. 102; *montana,* no. 103.

Subgenus CYCLAMASTRA Pils. & Van.

(*Series of A. umbilicata;* p. 149.)

83. A. MORTICINA n. sp. Pl. 36, figs. 8, 9.

The shell is umbilicate, rather thin, with globose last whorl. The spire is straightly conic, a little attenuated near

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the summit. Whorls 6, the embryonic smooth, convex, the rest slightly convex, finely striate, the last whorl inflated at periphery and base, weakly plicate close to the suture, which is thereby made irregular; obtusely angular around the deep umbilicus, which has a spiral gutter just within. The aperture is small, angular above, subangular at the base of columella; outer lip slightly thickened within. Columellar lip straight, but little dilated. Columellar lamella small and oblique.

Length 10.9, diam. 6.5, aperture 5 mm.

Length 10, diam. 6 mm.

West Maui: Kanaio (type loc.); Kahului, sand hills in the isthmian region (Baldwin).

Leptachatina extincta Pfr., in part, BALDWIN, Catalogue, 1893, p. 11 (Maui specimens).

This species is decidedly smaller than *A. extincta* Pfr., supposed to be Oahuan. *A. similaris* Pse., of *Kauai*, is very similar, but the embryonic whorls form a much wider, more obtuse cone than in *A. morticina*. *A. morticina* closely imitates *A. umbilicata* Pfr., of Molokai, but it differs by having shorter whorls, more distinct striation and a crenulate suture. They probably would not be separated specifically if found on the same island. The apical whorl was omitted by the artist in fig. 8. Only fossil examples have been found and there can be little doubt that the species is extinct.

The type specimens are of a dull red color (fig. 8). Others, from Kahului, are white, a little larger, with 6½ whorls, and the aperture is noticeably more angular at the base. The outer lip is more thickened (fig. 9). Length 12.3, diam. 6.8, aperture 5.7 mm. The largest specimen (labeled West Maui) is 13 mm. long, with 6½ whorls.

Series of A. sphærica (p. 147).

84. A. OBESA (Newcomb). Pl. 42, fig. 11.

"Shell dextral, depressed-conical, inflated, solid, striated, covered with an epidermis of dark umber color; whorls 5, rounded; apex acute; suture simple, well marked; aperture

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ovate, white; columella with a strong white plait; lip thickened within, simple. Length 0.4, breadth 0.35 inch. [10x 8.75 mm.]

"Entire animal of a sooty black; superior tentacles strongly clubbed, lower ones with a light-colored tip, granulations large; longer than the shell; motions very slow and timid" (*Newc.*).

The shell is imperforate or rimate, globose with short, concavely conic spire, rather thin, pale brownish under a dull chestnut or umber cuticle which covers the surface except in front of the aperture. 2½ embryonic whorls convex; finely striate, the last subangular and perforate. Later whorls rather coarsely, irregularly wrinkled, the last whorl rounded peripherally, more or less distinctly marked with very shallow, rather coarse spiral striæ. Aperture small, oblique, white within. The outer lip has a narrow internal rib. Columella white, short, bearing an obtuse lamella.

Length 13, diam. 9.5 mm.; 5½ whorls.

Length 10, diam. 7.2 mm.; 5½ whorls.

Maui: Haleakala (Newcomb, type loc.); Makawao and Kula (Baldwin).

Achatinella obesa NEWC., Ann. Lyc. N. H. of N. Y., vi, April, 1853, p. 24; *t. c.*, p. 329; P. Z. S., Lond., 1853, p. 143, pl. 23, f. 39.—PFR., Monogr., iv, 543.—BALDWIN, Catalogue, 1893, p. 9.—*Amastra heliciformis* Anc., THWING, Occas. Pap. B. P. B. Mus., iii, no. 1, pl. 3, f. 17.

The type locality is rather indefinite, but it is known to occur on the western (Kula) side of Haleakala. In the typical form (pl. 42, fig. 11, length 10.3, diam. 9 mm.) the spire is short, either almost straightly conic or concavely conic, as in the specimen figured. The last whorl is depressed. This form occurs in Kula, where the shells are more or less plastered with earth or excrement, which sometimes forms a peripheral keel, somewhat as in *A. agglutinans*, but less copious.

Specimens received from Mr. Baldwin, exact locality not stated, have the last whorl much less depressed. See measurements above and pl. 42, fig. 10; pl. 15, fig. 11. This high form may possibly be segregated as a variety. The surface

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is also dirty; a character recalling *Pterodiscus,* and lending some little evidence in favor of the view that *Pterodiscus* arose from ancestral *obesæ.*

Dr. C. M. Cooke informs me that the shell figured by Mr. Thwing as *A. heliciformis,* now in the Bishop Museum, is *A. obesa.*

85. A. AGGLUTINANS (Newcomb). Pl. 36, figs. 11, 12.

Shell narrowly umbilicate, depressed, angular at the periphery, pale yellow under a thin light-brown cuticle, the spire reddish-brown; more or less daubed with earth, which forms an irregular, broken flange at the periphery. Spire short, concavely conic, the finely striate, convex embryonic whorls projecting. Last whorl rather coarsely, irregularly striate, subacutely angular at the periphery, descending in front. Aperture white within, the outer lip but slightly thickened. Columella white, oblique, bearing an oblique fold. Length 8.5, diam., not including agglutinations, 10 mm.; whorls 5.

West Maui: Wailuku (Gulick).

Achatinella obesa var. *agglutinans* NEWCOMB, P. Z. S., 1853, p. 143, pl. 23, fig. 39*a*.—*Amastra carinata* GULICK, P. Z. S., 1873, p. 83 (no description).

This very peculiar species has characters which must have belonged to the ancestors of *Pterodiscus.* It is remarkable in *Amastra* for the peripheral keel and the bedaubed surface. Gulick based his species upon Newcomb's description and figure. The original description follows: " Var. *agglutinans.* Shell somewhat carinated on the last two whorls, with the keel extended by agglutinations, giving it a pagoda-like form."

The figures were drawn from a specimen received from Newcomb. Although this form has been united with *obesa* as a variety by Newcomb and Baldwin, the series of both examined leads us to agree with Gulick and Sykes that it is distinct. There seems no good reason for changing the name originally given by Newcomb.

Section HETERAMASTRA Pilsbry (p. 141).

Sinistral Amastræ with rather oblong, delicately costulate

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or thread-striate embryonic whorls, later whorls with a thin, dark cuticle, sometimes longitudinally streaked but *never mottled or figured;* columellar lamella receding and steeply ascending, generally small; axis rimate or imperforate. Type *A. hutchinsonii.*

Distribution, Lanai, Molokai, Maui and Hawaii.

These forms have been classified with *Laminella* by many writers, as Baldwin and Sykes, while others have considered them sinistral *Amastræ*, directly related to dextral forms of the region, a view taken by Borcherding, Hyatt, and apparently by Thwing. Differences in the embryonic whorls and the color pattern indicate that the relationship between these shells and the dextral Amastræ of Maui and Molokai is not close, though both groups are of common ancestry. The sinistral species form a natural group, which seems to have split off from *Amastra* at an early period.

The embryonic sculpture and dark, inornate coloration separate *Heteramastra* from *Laminella.*

Professor Hyatt intercalated these forms among dextral shells in various groups, as may be seen by reference to his classification, Appendix II.

Key to species of Heteramastra.

a. Diameter of shell equal to or exceeding half the length; surface not strongly rugose, smoothish or with weak sculpture.

b. Spire not contracted near the summit.

c. 12x6.9 mm.; Maui. *A. s. laticeps,* no. 86b.

c[1]. 10x5.5 mm.; last whorl swollen; blackish; Lanai. *A. fraterna,* no. 55.

b[1]. Spire noticeably contracted near the summit.

c. Moderately solid; spire brown, last whorl lighter colored; Maui. *A. soror,* no. 86.

c[1]. Thin, shell of nearly uniform dark color; about 5½ whorls.

d. Brown, thin, 10x5 mm.; Maui. *A. subsoror,* no. 87.

d[1]. Blackish, obese, 10.3x6.5 mm.; Lanai. *A. fraterna,* no. 55.

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a^1. Diameter of shell less than half its length.
  b. Embryonic whorls carinate above the suture, 14.7x 6.2 mm.; Hawaii. *A. sinistrorsa*, no. 104.
  b^1. Embryonic whorls not carinate.
    c. Rather large species, 15-25 mm. long; coarsely wrinkle-striate; whorls 7 to 7½.
      d. Maui, 15x7 to 24.5x7.3 mm. *A. hutchinsonii*, no. 89.
      d^1. Molokai, 20x7 mm. *A. h. villosa*, no. 89.
      d^2. Wider, 19x9 mm.; Maui. *A. farcimen*, no. 90.
    c^1. Smaller shells, with finer or weak sculpture.
      d. Shell finely striate.
        e. Brown; 7 whorls; Oahu. *A. elongata*, no. 54.
        e^1. Spire brown, last whorl paler; 5-6 whorls; Maui. *A. læva*, no. 88.
      d^1. Weakly wrinkled; 11.5x5.5 mm.; Molokai. *A. perversa*, no. 82.
      d^2. Weakly wrinkle-striate; spire brown, last whorl lighter; Maui. *A. soror*, no. 86.

86. A. SOROR (Newcomb). Pl. 48, figs. 1-5.

"Shell sinistral, conically-turrited; whorls 7, rounded; suture deeply impressed; aperture subovate, small; lip simple; columella very short, terminating in a twisted plicate tooth; epidermis thin, dark corneous above and light corneous below. Length 12, diam. five-twentieths of an inch.

"Var. *a*. Last whorl white, shell solid. Length 9, breadth five-twentieths of an inch.

"Var. *b*. Shell thin, dark corneous, polished. Length, 10, diam. four-twentieths of an inch.

"This species is the complete analogue of *A. acuta* [i. e., *A. elongata*] found in Oahu; it has a more ventricose aspect, and the striæ are more developed in the *A. acuta*" (*Newcomb*).

Maui (Newc.); Lahaina, W. Maui (Gulick coll.).

Achatinella soror NEWC., P. Z. S., 1853, p. 143, pl. 23, f. 38 [also fig. 36] (1854).—PFR., Monogr., iv, 548.—*Amastra soror* PSE., P. Z. S., 1869, 650.

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The typical form of *A. soror* may be considered that illustrated by Newcomb, whose figure is copied in our pl. 48, fig. 5. It is a variable species but whether the individual colonies are homogeneous or not we do not know. The spire is brown, darkest above, very little contracted near the summit; last whorl (or last two whorls) opaque yellow or buff, glossy, retaining fragments of a very thin olive or brown cuticle. First half-whorl of the embryo smooth, next whorl finely costellate, the riblets curved; next whorl with much finer riblets, as usual; a keel is visible just above the suture. Following whorls have a weak sculpture of low but nearly regular wrinkles along lines of growth. A delicate keel is visible on some of the whorls, just above the suture, and sometimes it extends as far as the penult. whorl. The aperture is white within, lip acute, slightly or heavily thickened within. Columellar lamella moderately strong, axis closed in specimens examined.

Length 13.8, diam. 7.1, aperture 6 mm.; 6½ whorls.

The specimens described and figs. 1, 2 are no. 1566, Boston Soc. N. H., from Lahaina, Gulick coll.

There is also a more slender form in coll. A. N. S. P. (pl. 48, figs. 3, 4). The spire is more contracted near the apex. The embryonic whorls are more finely striate and without distinct keel or angle above the suture. Following whorls have irregular wrinkles of growth, and are rather glossy. On the longest shell seen, a carina is visible above the suture. The aperture is very oblique, white, a little thickened within the outer lip. The columella is very short, dilated above, nearly closing the perforation. It bears a quite small fold which is larger within. The color is reddish-brown at the apex, gradually fading downwards, the last whorl being very pale-brown or white, with traces of a very thin brown cuticle.

Length 14, diam. 6.1, aperture 5.1 mm.; 7 whorls.

Length 13, diam. 6.1, aperture 5.1 mm.; 6½ whorls.

The exact locality of the type specimens as well as of this more slender form is unknown. This slender form may be referable to the following variety.

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86a. *A. soror interjecta* n. var. Pl. 48, figs. 9, 10, 11.

Smaller than *soror;* more solid than *subsoror.* Spire brown, slightly contracted above, the last whorl a lighter shade of brown or pale buff, covered with a very thin brown cuticle which seems to be more permanent than in *soror.* Whorls of the spire less convex than in *A. subsoror,* usually showing a delicate carina above the suture, but none is visible on the embryonic whorls. Aperture white within, having a rather thick callus lining. Columellar fold moderate.

Fig. 10. Length 11, diam. 6, aperture 5 mm.; 6¼ whorls (no. 57827).

Fig. 9. Length 11.5, diam. 6, aperture 5 mm.; 6½ whorls (no. 1566*a*).

Length 11, diam. 6.3, aperture 4.9 mm.; 6 whorls.

Lahaina: Cotypes no. 1566*a,* Boston Soc. and 57827 A. N. S. P.

There is often a pale line at the periphery of the last whorl. Dr. Newcomb sent out *A. subsoror* and *interjecta* as *soror,* evidently thinking them a form of his species. Working with museum specimens, we are unable to properly test the question of specific or racial distinction, which must be left to naturalists who can study the problem on the ground.

86b. *A. soror laticeps* n. var. Pl. 48, fig. 8.

Similar to *interjecta,* except that the spire is wider, contracts less above, the last whorl of the embryonic shell being decidedly wider. Aperture whitish, somewhat thickened within; columellar lamella receding, rather heavy and subvertical within. Length 12.8, diam. 6.9, aperture 5.5 mm.; 6 whorls.

Maui: Type no. 10213, A. N. S. P., received from Dr. Newcomb with *A. subsoror.*

87. A. SUBSOROR Hyatt & Pilsbry, n. sp. Pl. 48, figs. 6, 7.

The shell is sinistral, narrowly rimate, ovate-turrite, thin, dull brown. Spire a little contracted near the summit; the embryonic whorls reddish-brown, convex, delicately striate, the striæ arcuate, thin, narrower than their intervals.

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Subsequent whorls strongly convex, brown, with slight sculpture of low growth-wrinkles. Aperture quite oblique, brown within, the outer lip scarcely thickened internally; a white callus emerges, strengthening the basal lip within, its inward portion showing through the shell as a yellowish or whitish tract around the axial crevice. Columella straight, its edge narrowly dilated, bearing a strongly oblique, rather small lamella, which is stronger within; parietal film transparent.

Length 10, diam. 5, aperture 4 mm.; 5½ whorls.

West Maui: Lahaina (Gulick).

Smaller, more delicate than *A. soror*, with the whorls much more convex, last whorl brown, not opaque and yellow or whitish, except close to the perforation. Some shells of the type lot (no. 57786, A. N. S. P.) are decidedly broader than the type: Length 9, diam. 5.2, aperture 4 mm.; 5⅓ whorls. The largest shell seen is 10.5 mm. long.

In the young and half-grown stages the periphery is obtusely subangular, but the angle is usually not visible in adults. The shell is usually dirty, but not copiously smeared, as *A. hutchinsoni* generally is.

88. A. LÆVA Baldwin. Pl. 48, figs. 12 to 15.

"Shell sinistral, imperforate, rather thin, conically turrited, apex acute; surface striated with fine incremental lines, embryonic whorls with delicate radiating sulcations, color brown, with irregular patches of a dark fugacious epidermis. Whorls 6, somewhat convex; suture well impressed. Aperture oblique, oval, livid-white within. Peristome simple and thin. Columella terminating in a thin lamellar plait. Length 12, diam. 5 mm." (*Baldwin*).

East Maui: Mt. Haleakala.

Amastra (*Laminella*) *læva* BALDWIN, Nautilus, xix, April, 1906, p. 138.

"This species is the counterpart of *Laminella soror*, Nc. found on West Maui, but the latter is a larger and more obese shell" (*Baldwin*).

The specimens figured are from a series sent by Mr. Bald-

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win. The shell is rather *solid;* spire is a little contracted above, embryonic whorls finely costellate as in *A. hutchinsonii.* The following whorls have sculpture of *irregular rather coarse wrinkles,* and in some individuals there are distinct spiral striæ. Usually an inconspicuous angle or keel is visible just above the suture. The last whorl is yellow or buff, with fragments of a very thin brown cuticle. On the spire the tint darkens, becoming reddish-brown at the embryonic whorls. *Aperture white,* the lip acute, somewhat thickened within. Columellar lamella small, variable in size. Length 11.5, diam. 5.4, aperture 4.7 mm.; 5⅓ whorls.

In one specimen sent by Mr. Baldwin no trace of a columellar lamella is visible, the shell being normal otherwise (pl. 48, fig. 15). In another shell, old and dead, the lamella is very strongly developed (pl. 48, fig. 13). Length 12, diam. 5.9, aperture 5 mm.; 6½ whorls.

A. læva stands intermediate between *A. soror* and *A. hutchinsonii,* having sculpture and cuticle like the latter, while the shape of the spire is rather that of *soror.* Dr. Newcomb sent out specimens of *læva* under the name *elongata.* See p. 231.

89. A. HUTCHINSONII (Pease). Pl. 49, figs. 1, 2, 14.

"Shell acuminately turrited, sinistral, imperforate. Whorls 7, flatly convex, coarsely and irregularly striated longitudinally, not marginated. Sutures somewhat rude, well impressed. Aperture ovate, about two-fifths the length of the shell; columellar fold slight, oblique and tortuous. Shell covered with an earthy-brown epidermis; apex of a darker color; aperture and columella white, shining. Maui, Sandwich Islands" (*Pse.*)

East Maui: Makawao and Kula (Baldwin); Molokai: Waialua (Borcherding).

Helicter hutchinsonii PSE., P. Z. S., 1862, p. 7.—*Achatinella h.,* PFR., Monogr., vi, 180.—THWING, Orig. Descript., p. 177, pl. 3, f. 24.—*Amastra h.,* HARTMAN, Proc. A. N. S., Phila., 1888, p. 45, pl. 1, f. 9.

Molokai references.—*Amastra villosa* SYKES, Proc. Malac.

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Soc., London, ii, pt. 3, p. 129, October, 1896.—*Amastra* (*Laminella*) *villosa* SYKES, Fauna Hawaiiensis, p. 352, pl. 11, f. 24.—*Amastra elongata* Newc., BORCHERDING, in part, Zoologica, xix, 1906, p. 124, pl. 10, f. 24 (Waialua, Molokai).

The shell in Mauian specimens is usually rimate, not often imperforate as described by Pease. The embryonic whorls are very beautifully costellate, the riblets curved as usual. The later whorls have a coarse sculpture of uneven wrinkles. The later whorls have a thin rusty or chestnut cuticle over a light yellow under-layer which is exposed by wear on the wrinkles, and is plastered or daubed with blackish dirt. Beneath the cuticle the shell is white. The columellar lamella is small and strongly oblique.

Length 24.5, diam. 7.3, aperture 6 mm.; 7¾ whorls.

Length 15, diam. 7, aperture 6 mm.; 7 whorls.

There are two forms or races, a larger, with aperture one-fourth the length, and a smaller or typical race, aperture two-fifths the length, as in Pease's description. Both occur at Makawao. The species is readily known by its long contour and rude sculpture. "We have attached to this species the name of the Hon. F. W. Hutchinson, Judge of the Circuit Court, to whom we are indebted for several rare shells" (*Pse.*).

Having examined a series of shells from Molokai we are unable to find any character to separate them from the larger race of Maui. We agree with Borcherding that *A. villosa* is a synonym. The original description and figure (pl. 49, fig. 8) are given; also other figures representing Molokai specimens (figs. 3, 4). The original description follows.

"*Amastra villosa.*—Shell elongate-turrited, sinistral, subimperforate, rather thick; pale corneous covered with a brown epidermis. Whorls 7 to 7½, convex, longitudinally and irregularly, strongly striated; suture well impressed. Aperture lunate, nearly vertical; peristome unexpanded, acute, whitish; columellar lamina small. Length 20, diam. 7 mm." Molokai, Perkins. (*Sykes.*)

"This shell, nearly related to *A. hutchinsonii* Pease from

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Maui, may be separated by its greater size, more elongate spire, and the shape of the last whorl which is not so fusiform as in that species. The suture is also more deeply impressed. The specimen here figured [pl. 49, fig. 8, copied from Sykes] is not the one whose measurements were given in the original diagnosis, but a slightly smaller shell whose periostracum is better preserved" (*Sykes*).

In shells of maximum size the dull olivaceous-brown or reddish-brown cuticle is largely lost. The columellar lamella, in the Molokai shells we have seen, is very small, sometimes inconspicuous in front view.

90. A. FARCIMEN (Pfeiffer).

Shell subperforate, sinistral, oblong-conic, rather solid, somewhat rugose; whitish under a blackish epidermis; spire terminating above in an acute nude cone. Whorls 7, the upper flat, the last two very convex, last whorl a little exceeding one-third the length, subangular in the middle. Columellar fold compressed, oblique. Aperture oblique, semi-oval, white within; peristome simple, unexpanded, the columellar margin somewhat spreading. Length 19, diam. 9, aperture 8x5 mm. (*Pfr.*).

Maui (Newcomb, in Cuming coll.).

Achatinella farcimen PFR., P. Z. S., 1856, p. 334; Monographia, iv. 552. Not *Amastra farcimen* Pfr., HARTMAN, Proc. A. N. S., Phila., 1888, p. 56, pl. 1, f. 5.

Possibly a form of *A. hutchinsonii;* yet Sykes, who had opportunity to examine the type, makes no suggestion as to its affinities. He points out that Hartman's figure of a supposed "typical" *farcimen* belongs to some very different species. The aperture is longer in *farcimen* than in *hutchinsonii.*

Section AMASTRA s. str.

Series of A. nigra.

Moderately large shells, sometimes wholly wanting dark outer cuticle, but usually covered with a blackish cuticle which may be more or less deciduous, not conspicuously mottled or zigzag striped. Embryonic shell typically costate and

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carinate, but rarely these whorls are convex and striate. The series is closely related to the *pullata* group of Molokai.

91. A. BALDWINIANA n. sp. Pl. 43, figs. 4, 5.

Shell imperforate globose-conic, moderately solid, very pale brown or creamy-white under a thin, rather glossy dark-brown, black-streaked cuticle, which is inconspicuous or wanting above the last whorl. When preserved on the penult. whorl the cuticle is irregularly mottled or angularly streaked, as in *A. nigra;* and the light streaks of the last whorl show traces of spiral bands. The substance of the shell is white throughout or purplish-brown on the spire. The spire is straightly conic or a little contracted near the summit. First half-whorl smooth; next whorl strongly costate, and carinate above the suture, the following whorl more finely costulate. Later whorls with fine growth-lines, the last whorl smooth, or sometimes spirally malleated, very convex. Aperture short, white within, very slightly thickened within the outer lip. Columellar lamella strong and very oblique. Parietal callus thin.

Length 22.7, diam. 13.1, aperture 10 mm.; 6½ whorls.
Length 21, diam. 13.5, aperture 10 mm.; 6½ whorls.
Length 19, diam. 12, aperture 9 mm.; 6½ whorls.
West Maui: Wailuku (D. D. Baldwin).

A larger, less globose species than *A. nigra,* with the spire more broadly conic, and the last whorl less malleated or smooth.

92. A. NIGRA (Newcomb). Pl. 43, figs. 1, 2, 3, 6.

" Shell dextral, globosely acuminate, rather solid; the two lower whorls inflated, the superior ones subulate; whorls 6; the last two cut upon the surface into rude cicatrices by longitudinal striæ crossed by revolving elevations, irregularly distributed; superior whorls flattened, with closely-crowded, strong longitudinal striæ; suture simple, well impressed; aperture round ovate; columella short, terminating in a lamellar tooth; color yellowish-white, with a thin black epidermis. Length 14, diam. nine-twentieths of an inch " [17½ x11¼ mm.] (*Newcomb*).

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East Maui: Ulupalakua (Baldwin).

Achatinella nigra NEWC., Proc. Bost. Soc. N. H., v, 1855, p. 219; P. Z. S., 1855, p. 209; Amer. Journ. of Conch., ii, p. 210, pl. 13, f. 3.—PFR., Monogr., iv, 545.—THWING, Occas. Papers, B. P. B. Mus., iii, no. 1, p. 177.—BALDWIN, Catalogue, 1893, p. 9.—*Amastra nigra* PSE., P. Z. S., 1869, 649.—GULICK, Evolution, Racial and Habitudinal, pl. 1, f. 17.—*Achatinella globosa* GULICK, MS. *teste* Newc.

The second embryonic whorl is nearly flat-sided, with sculpture of rather strong curved riblets, and a carina above the suture; the next whorl has fine ribs, partly effaced in the middle. The very globose last whorl is conspicuously malleated, having flattened facets and irregular ridges running spirally and descending. The spire is brown, but the last whorl, under the lusterless blackish cuticle, is nearly white. The cuticle is more or less varied with angular streaks on the spire. The outer lip has a heavy rib or a thin callus within.

Length 17, diam. 11.2 mm.; whorls 6⅓.

Length 15, diam. 10 mm.

In one specimen received from Dr. Newcomb the whorl following the smooth initial half-whorl is convex, with a few low coarse folds and some fine striæ; next whorl finely striate, the striæ partly effaced in the middle (pl. 43, fig. 3). In all other respects the shell is a typical *nigra*.

A. nigra is related to the West Mauian *A. baldwiniana*. It has no other close relatives.

93. A. SUBCRASSILABRIS n. sp. Pl. 45, figs. 14, 15.

The shell is perforate, acutely ovate, *solid*, not glossy, outlines of the spire straight or very little contracted near the summit; whorls nearly flat. Embryonic whorls very finely striate, following whorls marked with growth-wrinkles, the last one spirally malleate below the periphery in the type (smooth in another specimen). Spire brown, the penultimate whorl becoming paler, last whorl cream-white, retaining small patches of a thin brown cuticle. Aperture slightly oblique, white within, the lip thickened by a rather strong white rib. Columella white, straight, narrowly reflexed, bearing a small

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white submedian fold. Length 12.5, diam. 7.4, aperture 6 mm.; 6¼ whorls.

East Maui: Kula, with *A. affinis,* etc. (Gulick).

Two specimens of this form were in a vial of the Gulick collection, no. 1541, Boston Society, with *A. affinis, A. malleata* and *A. a. cinderella,* labeled Kula, E. Maui. Compared with *A. crassilabrum* Nc., this species differs by its flatter whorls, more distinctly striate embryonic whorls, by the presence of brown cuticle on the last whorl, and the smaller columellar lamella. It is probably a relative of *A. nigra,* having the striate embryonic whorls of certain exceptional individuals of that species.

94. A. MAKAWAOENSIS n. sp. Pl. 43, figs. 7, 8, 9.

The shell is imperforate, oblong-conic, the outlines of the spire straight in the upper part, then convex. Ground-color very pale ochre or cream, or sometimes reddish-brown above, pale yellow below the periphery; except in front of the aperture it is covered by a dense, somewhat glossy cuticle, which is black (or with some reddish streaks) on the last whorl, copiously streaked with cream or brownish-white on the penult. whorl; earlier whorls red-brown with pale dots or streaks. Embryonic whorls flattened, the first coarsely costate, with a carina which is nearly concealed at the suture; second whorl more finely costulate; subsequent whorls with sculpture of growth-wrinkles and on the last two whorls numerous unequal, shallow spiral striæ (often weak or obsolete); the last whorl is not very convex, usually contracted, and usually has flattened, spirally descending facets, or malleation. Aperture white, oblique, the lip acute, somewhat thickened within. Columellar fold more or less thickened at the end, very obliquely ascending.

Length 20, diam. 10, aperture 9.5 mm.; 6½ whorls.

Length 20.5, diam. 10, aperture 8.3 mm.; 7 whorls.

Length 19, diam. 10, aperture 9 mm.; 6½ whorls.

East Maui: Makawao (Baldwin).

This species is one of several forms which have been grouped under the comprehensive name *A. mastersi.* It dif-

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fers from that species, as now restricted, by its oblong shape, the penultimate whorl bulging more, and the last whorl less convex, more or less contracted; by being covered with a blackish cuticle, and by the usual (though not invariable) spiral striation, or spirally descending malleated facets. It is also less glossy.

The penultimate and last whorls are sometimes uniform black, except where the cuticle is lost in front of the aperture and above the last half-turn of the suture. Usually the penultimate whorl and front of the last are more or less streaked. They are never marked with angulated streaks, though at times there is some light maculation or mottling on some of the dark streaks.

A form somewhat similar to this has been figured by Borcherding from Molokai (Zoologica, Heft. 48, p. 116, pl. 10, fig. 16). It is herein described as *A. borcherdingi*, as I believe it to be quite distinct from *mastersi* and *makawaoensis*.

95. A. MASTERSI (Newcomb). Pl. 43, figs. 12-17.

"Shell dextral, thin; whorls 7, rounded, slightly rugose above, the last strongly inflated; apex acute; suture well impressed; aperture ovate; lip simple; columella short, with a thin lamellar plait; color of shell white or rich chestnut, with traces of a thin brown epidermis; within white or bluish-white.

"The size varies much in this species, and the coloring is also various, running from pure white through various tints to a light mahogany. The lower part of the shell is not infrequently white, and the upper portion bright chestnut or rose-colored.

"Length sixteen-twentieths, width eight-twentieths inch [=20x10 mm.]. Mani." (*Newc.*)

"Animal longer than the shell, of a fine flesh-color, covered with granulations tipped with carmine; tentacles and anterior superior portion of the body dark-brown or black. Motions fearless and active. An inhabitant of bushes (the 'Olona')" (*Newc.*).

East Maui: Makawao (Baldwin, Thwing).

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Achatinella mastersi NEWC., P. Z. S., Lond., 1853, p. 153, pl. 24, fig. 67 (1854); Ann. Lyc. N. H. of N. Y., vi, 1858, p. 332 (animal).—*Laminella mastersi* Nc., W. G. BINNEY, Ann. Lyc. N. H. of N. Y., x, p. 335, pl. 15, figs. 7, 9-11 (jaw and teeth); Ann. N. Y. Acad. Sci., iii, 1884, p. 98, pl. 16, f. E (jaw); pl. 6, fig. E (*teeth*).

Newcomb's description is given above and his figure is copied, pl. 43, fig. 12. The original locality was Maui. In his paper of 1858, where the animal is described, Newcomb states that "*A. mastersi* is an inhabitant of Molokai, and is sparsely found on Maui." It is evident that more than one form was included by Newcomb in his definition of the species. The form selected for his figure is, as Mr. Thwing has implied, the bicolored race from Makawao, in East Maui. While this does not agree with all of the description, it was evidently regarded by Newcomb as a typical *mastersi*. He records other species from Makawao, and this was doubtless the type locality of *mastersi*.

The shell is glossy, the upper half of the last whorl rich chestnut, lower half yellow, spire brown, the embryonic whorls reddish or dull-purple. Other shells have the last whorl chestnut, spire either a lighter or a darker shade. *There is no outer layer of dark cuticle.* The outlines of the spire are convex. The second embryonic whorl is strongly costate, with a carina which is concealed at the suture. Following whorls are irregularly plicate below the suture, the last whorl well rounded, *not malleate*. Aperture white, the lip acute, not thickened within. Columellar fold small and oblique. Axis imperforate.

Length 18, diam. 10 mm.; 6 whorls.

Length 18, diam. 9.5 mm.

In another color-form the shell is pale-yellow, spire gray-brown (pl. 43, fig. 17).

Typical *A. mastersi*, as restricted to this form, is special to East Maui, occurring on the northeastern flank of Haleakala, on one of the routes to the crater. A more globose form, length 16, diam. 10 mm., with 5½ whorls, occurs at Honomanu, inland from Keanae, north of Haleakala crater.

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The series examined from this place is in the C. M. Cooke collection.

Series of A. assimilis.

Small or moderate sized shells, generally with *mottled or zigzag-striped outer layer of dark cuticle.* Embryonic whorls typically costate and carinate. Common to East and West Maui and Molokai.

Perhaps an additional Series should be erected for *A. johnsoni* (no. 100). *A. erecta* (no. 101) and *A. subpulla* (no. 96*d*), which have plain or banded coloration, and so far as known have plain, not figured cuticle.

96. A. AFFINIS (Newcomb). Pl. 44, figs. 1-4, 6.

" Shell acutely conical; whorls 6, rounded, not margined; suture well impressed; aperture ovate; lip thin; columella with a white lamellar twisted tooth; color white, roseate or salmon, with traces of a dark-brown epidermis; last whorl lighter-colored than the upper ones. Length 12, diam. 5¾ twentieths of an inch " (=15x7.2 mm.) (*Newc.*).

East Maui: Kula (Newcomb).

Achatinella affinis NEWC., P. Z. S., 1853, p. 142, pl. 23, fig. 35 (1854).—PFR., Monogr., vi, p. 180.—*Achatinella goniostoma* PFR., P. Z. S., 1855, p. 103; Monographia, iv, p. 550.—*Amastra rustica* GULICK, in Gulick and Smith, P. Z. S., 1873, p. 84, pl. 10, f. 17.

A. affinis, rustica and *pupoidea,* together with the forms *bigener, cinderella* and *subpulla,* distinguished by Hyatt, make up a group of very closely-related forms, which seem to me inextricably connected; yet as my knowledge of them is limited to a couple of hundred museum specimens, without field notes, my course should not unduly prejudice a naturalist who may study the group at Kula, its headquarters. As a whole, the species differs from *A. assimilis* by its generally smaller size.

Newcomb's type figure of *affinis* is copied, pl. 44, fig. 4. Figs. 1 to 3 represent typical specimens enlarged to show the sculpture. The embryonic whorls are brown or whitish, flattened, strongly costate, and carinate above the suture, the

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carina often conspicuously projecting. The following whorls of the cone (which is straightly conic above the penultimate whorl) are unevenly striate, and the intermediate whorls are usually more or less pitted, cicatricose, or irregularly malleated, the impressions gray, fleshy or pink. The last whorl is yellowish white, generally with small fragments of a brown cuticle adhering on the last half. In some shells there remain traces of angular dark lines of cuticle on the last whorl. The aperture is white, with a narrow lip-rib or none. Columella very narrow with a small oblique fold in the middle.

Other specimens of the same lot from Kula have the embryonic whorls more finely striate, and in one shell they are convex and finely striate; so that this species varies much as figured for *A. nigra* in characters of the embryo, while the later stages seem alike.

In some lots the carina of the neanic whorls is concealed at the suture; in others it may show above the suture on the third whorl.

A. rustica Gulick, according to paratypes from Kula, received from Gulick (pl. 44, figs. 12 to 16), is not, I think, specifically separable. On the last half-whorl it usually retains much of the cuticle, which is dark olivaceous or brownish, streaked and mottled with lighter, or variegated with dark zigzag streaks on a pale ground. The original description follows.

"*Amastra rustica* Gk. Shell dextral, imperforate, ovate-conic, striated lightly with growth-lines, very pale reddish under an olivaceous cuticle. Whorls 6, a little convex, the first two very strongly, the third lightly sulcate. Suture simple, not very deep. Aperture small, not as long as the spire, somewhat reddish; peristome arcuate, thin; columella short, provided with an inconspicuous fold, joined to the lip by a very thin callus. Length 14½, diam. 7⅓ mm. Kula, in East Maui, on the ground. It is allied to *Am. affinis* Nwc., but is readily distinguished by its convex spire" (*Gulick*).

A. goniostoma has been accepted as a synonym of *affinis* by Newcomb, Hartman and Sykes. The description follows.

"*Achatinella goniostoma* Pfr.—Shell rimate, dextral, tur-

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rited, solid, obliquely striatulate; corneous-gray under a deciduous fulvous epidermis. Spire elongate-conic, the apex acute; suture subcrenate. Whorls 8, rather flat, the penultimate more convex, the last whorl scarcely more than one-third of the length, rotund. Aperture oblique, elliptical, angular at both ends; peristome unexpanded, produced basally, the margins joined by a callus, right margin somewhat labiate within; columellar margin somewhat dilated, adnate. Length 16, diam. 7⅔, aperture 6 mm. long, 3.5 wide. Sandwich Is., Mus. Cuming " (*Pfr.*).

Dr. Newcomb (Ann. Lyc. N. H. of N. Y., vi, 328) remarks: " Two of the three specimens in Mus. Cuming labelled *A. goniostoma* Pfr., clearly belong to this species [*affinis*]; a larger specimen may be distinct."

96a. *A. a. pupoidea* (Newcomb). Pl. 44, figs. 5, 9, 10, 11.

Shell dextral, cylindrically elongate; whorls 7, rounded; suture deep; aperture small, subovate; lip simple; columella short, lightly toothed; epidermis thin, of a light brown, beneath which the body-whorl is white, the three above pinkish, and the others leaden; brown zigzag undulations are sometimes found on the upper portions of the lower whorls. Length 14, width five-twentieths of an inch [17.5x6.25 mm.] (*Newc.*).

East Maui (Newcomb).

Achatinella pupoidea Nc., P. Z. S., 1853, p. 144, pl. 23, fig. 42 (1854).

Newcomb's original figure is copied, fig. 5. Numerous specimens before us differ from *affinis* only by being more lengthened, a variable character. Some cuticle is retained on the last whorl. The pale ground is sometimes reddish above the periphery, or has pale-reddish bands there. A delicate carina is generally visible above the suture as far down as the fourth whorl. The size varies.

Length 17, diam. 7, aperture 6 mm.; 7 whorls.

Length 14.2, diam. 6.5, aperture 6 mm.; 6½ whorls.

Length 17, diam. 8, aperture 7 mm.; 6½ whorls.

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96b. *A. a. bigener* Hyatt, n. var. Pl. 44, fig. 7.

Smaller than typical *affinis,* creamy, the apex brown or white, last whorl retaining dark cuticle in angular or zigzag lines. Apex with typical costation and carination; whorls fewer.

Length 12, diam. 6.2 mm.; whorls 5½.

Length 11.9, diam. 6.1 mm.; whorls 5½.

Maui: Types no. 57685, A. N. S. P.

A form without cuticle, except for some shreds close behind the lip, is whitish below the periphery, flesh-colored, with numerous pale lines above it. Length 12, diam. 6.8 mm.; 5½ whorls. This form was called *A. bigener* var. *abberans* Hyatt, MSS. (pl. 44, fig. 8). The exact locality is unknown. The figured type is 117264, U. S. Nat. Mus.

96c. Var. *cinderella* Hyatt, n. v. Pl. 45, figs. 1, 2.

Smaller than *affinis,* white mottled with flesh-color, or pinkish-brown with scattered white maculæ, or with white streaks also. Length 10.7, diam. 6 mm.; 5½ whorls. Kula.

This form, distinguished by Hyatt, is based upon no. 1546 of the Gulick coll., Boston Society collection. Figured from the cotypes.

96d. *A. a. subpulla* Hyatt & Pilsbry, n. subsp. Pl. 45, figs. 3, 4.

The shells are stouter than in *cinderella.* The color of one is uniform brown without bars and it has a lighter or yellow tone along the shoulder of last volution, apex ashen (fig. 4). The other shell has broad pearl-grey bands cut up by smaller brown bands and a pearl-grey area around the columella on the base. The preceding whorl is brown with light pearl-grey shoulder, and apex ashen. These are the colors and ornaments of *A. pulla* of Lanai, but the shell is distinct in being a little stouter or more globose than in that species. It is also wider than *A. johnsoni.* There is no trace of an outer layer of cuticle. The apex is costate and carinated. Length 11, diam. 6.3 mm. (fig. 3, type).

Kula, East Maui, associated with var. *cinderella.* Cotypes in coll. Boston Society.

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This may be specifically distinct from *A. affinis*, as Hyatt believed; but variation in this group is so imperfectly understood that for the present it may be described as a subspecies.

96e. *A. a. kaupakaluana* n. subsp. Pl. 46, figs. 1 to 6.

The shell is imperforate, oblong-conic, rather solid; pale yellowish, becoming brown on the spire or near the apex, in large part covered by a thin, smooth olivaceous cuticle, often marked with dark oblique stripes on a paler ground on the front, and becoming denser and chestnut-colored on the last part of the last whorl. It is worn away in front of the aperture. First whorl costate and carinated, second whorl much more finely costulate; subsequent whorls somewhat plicatulate below the suture. Aperture impure white within, often pinkish towards the black lip-edge. Columellar fold small, obtuse, median.

Length 16, diam. 8.9, aperture 7.6 mm.; 6⅓ whorls.

Length 16, diam. 8.3, aperture 7.3 mm.; 6½ whorls.

East Maui: Kaupakalua (Baldwin). Cotypes no. 2156, coll. C. M. Cooke. and 104760, A. N. S. P.

Darker colored than *A. affinis*, retaining more cuticle, and rather different in pattern; it has an appearance of distinctness. Inhabits a district north of Kula, the home of *A. affinis*.

Two other lots in the Cooke collection without exact locality data are referable to this subspecies. In lot 2150 the shell is rather solid, obese, length 15, diam. 9 mm., cuticle blackish, the mouth rose or white (pl. 46, figs. 1, 2). In lot 2149 the shell is thinner, cuticle black (pl. 46, figs. 3, 4).

97. A. NANA Baldwin. Pl. 43, figs. 11, 20, 21.

The shell is rimate, ovate-conic, thin; impure whitish or pale brown, the apex dark brown, covered (except in front of the aperture) with a brown or olivaceous-brown cuticle, which is varied with light streaks or zigzag stripes. Embryonic shell costate and carinate, later whorls more or less irregularly wrinkle-striate. Aperture small, the lip some-

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what thickened within. Columellar fold rather sharp. The spire has nearly straight outlines, whorls but slightly convex.

Length 12, diam. 6.7, aperture 5 mm.; whorls 6¼.

Length 11.2, diam. 6.6, aperture 5.4 mm.

" Animal when extended in motion as long as the shell. Mantle light brown. Foot above and below brown with spots of deeper shade on the sides. Tentacles and front above almost black " (*Baldwin*).

East Maui: Makawao. Common, but very local in its distribution, in a belt of forest land about 4,000 feet above sea level (Baldwin).

Amastra nana BALDWIN, Proc. A. N. S., Phila., 1895, p. 232, pl. 11, figs. 48, 49.

Shorter, thinner, less calcareous and darker than *A. affinis,* and much smaller than *A. a. kaupakaluana,* which occurs farther north. The description and figures are from the types, no. 65718, A. N. S. P.

The color pattern varies within wide limits, as shown by the figures.

M.C.Z. 38996

There is in the Boston Society collection a shell, no 13423, said to be from Molokai, which Hyatt described in MS. as a new species, but which seems to me to be identical with *nana.* The shell (pl. 42, fig. 1) is subrimate, thin, ovate-conic, not shining; outlines of the spire straight. Embryonic whorls flat, strongly costate and conspicuously carinate, purplish-brown. Following whorls very slightly convex, marked with rather distinct wrinkles of growth, reddish-brown under a thin pale-brown cuticle which is profusely but indistinctly marked with abruptly-waved longitudinal stripes of reddish-chestnut, fading at their edges. Last whorl well rounded at the periphery. Aperture dark within, the lip thin. Length 9.2, diam. 5.8, aperture 4.9 mm.; 5½ whorls. The locality assigned seems to me doubtful, but the description and figure are inserted to call attention to the matter.

98. A. MALLEATA Smith. Pl. 45, figs. 5, 6

Shell acutely-ovate, dextral, striated with growth-lines, prettily malleated, dirty whitish variously colored with a

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brownish-olivaceous epidermis. Whorls 6, a little convex, the first three strongly radially sulcate; suture simple. Aperture white; peristome thin, very slightly thickened within; columellar fold thin. Length 14, diam. 8 mm. (*Smith*).

East Maui: Kula, on the ground (Gulick).

Amastra malleata SMITH, P. Z. S., 1873, p. 85, pl. 10, f. 18.

The type (pl. 45, figs. 5, 6) and another specimen, from the Boston Society collection, are before us. It is very closely related to *A. affinis,* and may prove to be connected with that species, but *the shell is quite noticeably broader* and the last whorl is more malleated than usual in *affinis.* The pattern of the cuticle is the same as in "*rustica*". The type measures, length 14, diam. 8, aperture 7 mm.

A third shell of the original lot (pl. 45, figs. 7, 8) is more inflated, the last whorl very densely malleate, and marked with close pattern of forwardly converging olive lines. Length 13, diam. 8.2, aperture 7 mm. Still another specimen with the same markings is intermediate in shape between the preceding and the typical shells.

99. A. CONIFERA Smith. Pl. 45, figs. 10 to 13.

Shell ovate-conic, dextral, lightly striated with lines of growth, very pale-reddish, partly covered with brownish-olivaceous epidermis. Whorls 6½, a little convex; the first 2½ to 3 reddish, strongly radially sulcate, with a spiral cord at the base. Suture simple. Aperture whitish; peristome thin, blackish, slightly thickened; columellar fold thin. Length 17, diam. 9 mm. (*Smith*).

East Maui: Kula, on the ground under dead leaves (Gulick).

Amastra conifera SMITH, P. Z. S., 1873, p. 85, pl. 10, f. 11.

The type (pl. 45, figs. 10, 11) and four other specimens of the original lot (figs. 12, 13) in the Gulick collection, Boston Society of Natural History, are before us, with others. All are imperforate, thin, with the outlines of the spire either straight, or a little contracted near the summit. The color varies: (1) Very pale reddish, becoming lighter, more creamy on the last whorl. (2) Spire rather dark reddish-brown,

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with a white sutural border, the last whorl cream-white. (3) Cream-white throughout, or with only the embryonic whorls reddish-brown. Very little of the thin, olive or olive-brown cuticle is retained above the last whorl. What there is on the penult. whorl and front of the last is marked with angular dark figures, or mottled with light on a dark ground or net-work. On the latter part of the last whorl it becomes continuous except where worn off. The apex is of the typical costate and carinate form. *The last whorl is angular at the periphery*, the angle usually rather sharp and distinct in front, but sometimes quite weak. There is a very thin callus within the lip in the oldest shells, but usually it is quite thin. A blackish cuticular edge is present in the type, but not in other examples.

Length 16.5, diam. 9.7, aperture 7.9 mm.; 6½ whorls (type).

Length 16.5, diam. 10, aperture 8 mm.

Length 15, diam. 8.7, aperture 7 mm.

Length 15, diam. 9.5, aperture 8.2 mm. (not mature).

It is a larger, more capacious shell than *A. affinis* (or *rustica*), further differing by the angulation of the last whorl and the less elaborately figured cuticle. *A. montana* is a shorter shell with rounded periphery.

100. A. JOHNSONI Hyatt & Pilsbry, n. sp. Pl. 45, fig. 16.

Shell nearly imperforate, oblong-conic, rather thin, somewhat glossy. Outlines of spire straight above, a little convex below, the whorls nearly flat. Embryonic whorls costate, the second carinate, about as in *A. affinis*. Later whorls marked with growth-wrinkles. Color brown, the last whorl partially covered with a thin, darker cuticle having some darker and lighter streaks but no oblique or angular markings. Aperture whitish within; lip acute, very little thickened within. Columella straight, reflexed above, bearing a small, strongly oblique lamella. Length 11.3, diam. 6, aperture 5.1 mm.; 6½ whorls.

West Maui: Wailuku (Gulick, in coll. Boston Society).

This shell is narrower than *A. affinis subpulla*, with a much

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smaller columellar lamella. The monotype was found by Hyatt among Gulick's shells labeled *assimilis*. It is evidently a mature shell, much narrower than young *assimilis* of the same length. Named for Mr. C. W. Johnson, Curator of the Boston Society of Natural History.

This form, *A. erecta* and *A. subpulla* do not agree with the *assimilis* group in coloration, but they are closely related in other characters and may be aberrant members of that series.

101. A. ERECTA (Pease).

Shell dextral, imperforate, rather solid, turrited, irregularly delicately striate, slightly shining, covered with a thin epidermis; whorls 7, convex, the last forming 2/5 the length; suture impressed; columellar fold laminiform, thick, slightly oblique. Aperture ovate; columella arcuate. Straw-colored, light-reddish or brownish with the apex purple. Length 15, diam. 7.5 mm. (*Pse*).

Maui (coll. Pease and Crosse).

Laminella erecta PEASE, Journ. de Conchyl., 1869, p. 174. —*Amastra* (*L.*) *erecta* Pse., SYKES, Fauna Hawaiiensis, p. 349.

"I know of no other species with which *L. erecta* may be compared. The shell is very regular in shape, its whorls increasing regularly" (*Pse.*). "Close to *A. micans* Pfr." (Sykes).

This species seems to be unknown to collectors in the Islands, as it is to us. Pease and Sykes place it in *Laminella*, but from the description it seems to be an *Amastra*. The presence of enough epidermis to be noticed by Pease is against its reference to *Laminella*. Dr. C. M. Cooke in a recent letter states that *L. erecta* is identical with *A. micans* (p. 210), an opinion which seems to me well founded.

102. A. ASSIMILIS (Newcomb). Pl. 27, fig. 17; pl. 46, figs. 9 to 14.

Shell conically elongate, acute above; whorls 7, rounded; suture well impressed. Aperture small, ovate, columella very short, plicate, twisted; lip acute, thickened slightly within. Color white or salmon, sometimes the lower half of the last

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whorl white and the rest of salmon, within pure white. Length 11, diam. 5¼ twentieths of an inch [14x6.5 mm.] (*Newc.*).

W. Maui (Newcomb); Wailuku and Lahaina (Gulick).

Achatinella assimilis NEWC., P. Z. S., 1853, p. 148, pl. 23, f. 53 (1854).—*Amastra assimilis* Newc., SYKES, Fauna Hawaiiensis, p. 334.—*Achatinella deshaysii* MORELET, Bulletin de la Société d'Histoire naturelle du Département de la Moselle, viii, 1857, p. 27.

This shell has much in common with *A. affinis* and *pupoidea* of East Maui in texture, color and apical sulpture. The original enlarged figure of Newcomb's type is copied on pl. 27, fig. 17.

A. assimilis is frequently larger and usually more robust in figure than *A. affinis;* yet when all is said, the specific distinction is chiefly geographic; this is West Mauian, the other East Mauian. Each specific name denotes in the conventional mode, a series of more or less divergent races, sometimes very variable and possibly composite or hybrid.

Iao valley above Wailuku is (or in the time of Newcomb and Gulick was) a locality for shells agreeing with the typical form of *assimilis*. On the western side of the summit of West Maui, in Lahaina opposite the head of Iao valley, the shells are larger and more obese, and have often been referred to *A. mastersi*—certainly an error.

Pl. 46, figs. 9, 10, 11, 13 represent Wailuku specimens. The ground-color is whitish throughout, whitish with ruddy spire, or coffee-tinted above, white below the periphery. Over this there is a much abraded, dark cuticle, forming zigzag lines or angular spots, or sometimes an olive and brown cuticle is streaked and mottled with whitish (figs. 9, 10). The surface is subplicate below the suture, elsewhere more or less distinctly, rather coarsely striate. Embryo costate and carinate (the carina sometimes almost concealed). Columellar fold small and median. Specimens measure:

Length 13, diam. 7.2, aperture 6 mm.; whorls 5½.

Length 15.5, diam. 8.3, aperture 7 mm.; whorls 6.

Another shell from Wailuku is figured, pl. 41, fig. 8. The

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white ground is nearly covered with a whitish cuticle densely marked with zigzag stripes. The last whorl is carinate in front, and somewhat malleated below the carina. On the last third of the last whorl the cuticle becomes nearly uniform and blackish. Length 14, diam. 8.2 mm.

There are also some stouter shells in this lot, resembling those from Lahaina.

In the Boston Society collection (part of no. 1519) there is a small form with the ordinary Waialua shape, which was segregated by Hyatt as *subassimilis* (pl. 46, figs. 7, 8). It has a ground-color of pale fleshy-brown above the periphery, the embryonic whorls dark brown, and the base brown-tinted whitish. Cuticle remains in angular blackish figures on a pale ground on the last part of the penult. whorl, becoming dense, black and continuous on the latter half of the last whorl. The carina of the neanic stage is visible above the suture on the penult. whorl, and continued as an impressed line on the first half of the last whorl. Aperture as in *assimilis*. Length 12.7, diam. 7.1, aperture 6 mm.; 6 whorls. Waialua, Gulick coll. Probably a local race.

In Lahaina (pl. 46, figs. 12, 14, 15) the shells are mainly larger, more obese though some also occur exactly similar to those of Wailuku. The color-patterns are as described above, with transitions between them, but most large shells are almost wholly denuded of the outer cuticle.

Fig. 14. Length 18, diam. 10, aperture 9 mm.; 6 whorls.

Fig. 15. Length 17, diam. 11, aperture 9.4 mm.; 6 whorls.

Fig. 12. Length 16, diam. 9 mm.

Length 15, diam. 8 mm.

This form resembles some of the Molokai shells identified as *A. mastersi* by Herr Borcherding, but which are now referred to *A. borcherdingi*.

Morelet's original series of *A. deshaysii*, now in the British Museum, has been examined by Mr. Sykes, who states that two specimens belong to *A. assimilis* and one to *A. biplicata*. The diagnosis, translated below, applies to *assimilis* only.

"*Achatinella deshaysii*. Shell slightly rimate, ovate-turrite, longitudinally rugose, fleshy straw-colored under a deep

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chestnut epidermis which is partly worn off; spire turrite, the apex mucronate and beautifully plicatulate; whorls 7, the upper flat, following convex, the last inflated, tapering basally, more than half the total length. Columella straight, provided with a spiral callus. Aperture small, oval, subangular below; peristome simple, unexpanded; columellar margin very narrowly reflexed. Length 22, diam. 10 mm. Sandwich Islands" (*Morelet*).

103. A. MONTANA Baldwin. Pl. 43, figs. 18, 19.

The shell is imperforate, ovate-conic, thin; spire straightly conic, a little concave near the apex; covered (except in front of the aperture) with a blackish-brown cuticle copiously streaked or zigzag striped with yellowish. After the smooth initial half-whorl, the embryo is coarsely ribbed, the ribs protractive, terminating in a carina above the suture; on the next whorl they are much finer, becoming short and disappearing. Neanic and last whorls rather finely marked with growth-lines. Above the suture a peripheral carina may usually be traced as far as and sometimes upon the penultimate whorl. The whorls of the spire are nearly flat. Last whorl large, inflated. Aperture whitish within, the lip thin, acute. Columellar fold median, oblique and rather thin.

Fig. 18. Length 15, diam. 9.1, apert. 7.9 mm.; 6½ whorls.

Length 14, diam. 8.5, apert. 7.9 mm.; 5¾ whorls.

Length 14, diam. 9.5 mm. (*Baldwin*).

"Animal in motion as long as the shell. Mantle dark-brown with a light-brown border. Foot and tentacles almost black. Head above coarsely granulated" (*Baldwin*).

West Maui: Mt. Kukui, 6000 ft. elevation (*Baldwin*).

Amastra montana BALDWIN, Nautilus xix, April, 1906, p. 136.

"This species was found in company with *Laminella alexandri* Newc., at an altitude uncongenial to most Achatinellid species" (*Baldwin*). It is thinner, darker and more inflated than *A. assimilis* Newc. Fig. 18 was drawn from one of the type lot, received from Baldwin. This individual is streaked with yellow but has no zigzag markings. Other shells of the

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type lot have longitudinal zigzag stripes, which sometimes partly anastomose to form a net-work, as in fig. 19.

AMASTRÆ OF HAWAII.

In Hawaii Amastræ have been found from the Kohala Mountains and the northern slopes of Mauna Kea, district of Hamakua, to the southeastern slope of Mauna Loa in Kau district. They also occur with many other land shells as fossils in Holocene deposits at the upper edge of the Waimea plains, at about 3000 ft. elevation, at Mana and Palihoukapapa, in northern Hamakua. "At Mana the shells occur in horizontal strata two or three inches thick and under a deposit of about a foot of humus." At Palikoukapapa they are in "pockets, sometimes containing a bushel or more of shells." Similar deposits occur above Honakaa, and they are probably widely spread. The region is said to have been covered with fallen tree-trunks less than fifty years ago. Our knowledge of the deposits is due to a paper by Mr. H. W. Henshaw, Journal of Malacology, xi, Sept., 1904, p. 56, and to shells sent by Mr. Baldwin.

The Hawaiian species belong to two groups, both of Amastrelloid type. The *flavescens* series is not distinguishable by the shell from typical Kauaian *Amastrella*. The *melanosis* series differs by its striate embryo and tendency to angulation in the later stages, and forms a specially Hawaiian modification of *Amastrella*.

We have elsewhere alluded to the possibility that *A. luteola* Fér. may turn out to be an Hawaiian species of the *flavescens* series.

Key to Hawaiian species of Amastra.

I. Shell sinistral. *A. sinistrorsa*, no. 104.

II. Shell dextral.

a. Embryonic whorls nearly smooth, marked with faint growth-striæ only; shell rather solid, with thin yellow or brown cuticle.

b. Diameter about two-thirds the length; length about 12 mm. *A. hawaiiensis*, no. 110.

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b^1. Diam. less than two-thirds the length; length 14 to 20 mm. *A. flavescens,* no. 109.

a^1. Embryonic whorls very finely, sharply striate; shell thin, with brown or black cuticle (wanting in fossil forms); lip thin.

b. Openly umbilicate, broadly conic, subangular peripherally; 21x16 to 23x18 mm.; fossil. *A. senilis,* no. 105.

b^1. Perforate.

c. Ovate-conic, diam. more than half the length, the last whorl usually slightly angular, with black cuticle. Length 13 to 14, diam. 8 mm. or smaller. *A. melanosis,* no. 106.

c^1. High-conic, the last whorl rounded; 15.5x8 mm., with 6¾ to 7 whorls; fossil. *A. conica,* no. 107.

c^2. Similar but smaller, dull brown; recent. *A. c. gyrans,* no. 107a.

c^3. Yellow streaked with chestnut; 15x7 mm. *A. c. kohalensis,* no. 107b.

c^4. A little broader, length 15.3 to 18, diam. 9 mm.; whorls 6 to 7; fossil. *A. fossilis,* no. 108.

Section HETERAMASTRA Pilsbry (p. 283).

104. A. SINISTRORSA Baldwin. Pl. 49, figs. 6, 7.

Shell imperforate, sinistral, lanceolate, rather thin. Spire long, with straight outlines. First half-whorl smooth, convex, forming an obtuse apex; next whorl flattened, subacutely carinate near the base, sculptured with fine, curved riblets; on the next whorl the carina weakens and then disappears, and the riblets become finer and closer. Later whorls are moderately convex, rather rudely sculptured with growth-wrinkles, not angular above the impressed suture. Aperture strongly oblique, the outer lip thin. Columella straight, its edge narrowly reflexed and adnate above; bearing a small and very oblique fold. Length 14.7, diam. 6.2, aperture 5.7 mm.; 6½ whorls.

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Hawaii: Mana, Hamakua district, fossil (H. W. Henshaw).

Amastra (*Laminella*) *sinistrorsa* BALDWIN, Nautilus, xix, April, 1906, p. 138.—HENSHAW, Journ. of Malac., xi, p. 63.

This apparently extinct species from the Holocene deposits of the Hamakua district, is the only member of its group found on Hawaii. It is more slender than the Mauian *A. hutchinsonii,* and differs by its carinate embryonic whorls and less coarse sculpture. Described and figured from the type specimen, kindly lent by Mr. Baldwin. Another shell of the original lot is slightly broader. Like all the shells of the Mana deposits, it has lost all color and cuticle.

Section AMASTRELLA Sykes (p. 151).

Series of A. melanosis.

By the cuticle and striate apex, *A. melanosis* and its allies are very similar to Oahuan Amastrellas of the *inflata* group. Other species, such as *A. senilis* and *fossilis* have the umbilicus of *Cyclamastra,* but differ from that group by the sculptured embryonic whorls. While the group is a natural series, its species are rather diverse, indicating long isolation of a stock derived from rather generalized ancestors. Northern Hawaii, by its mature topography and the great cliff gnawed by the waves, may be as old as any of the islands; and its Amastrellæ were no doubt due to an early radiation of these primitive Amastræ.

105. A. SENILIS Baldwin. Pl. 47, fig. 5.

The shell is openly *umbilicate, broadly conic,* thin. Spire conic with nearly straight outlines, the apex subacute, embryonic whorls closely, finely and sharply striate; following whorls moderately convex, roughly marked with growth-wrinkles, the last three whorls sometimes showing small, very shallow spiral striæ, the last whorl carinate at the periphery in front, *coarsely malleated,* producing irregular, spiral, descending ridges between the flattened facets. The columella is dilated above, vertical, and bears a small fold. The umbilicus is cylindric and deep, 2 mm. wide.

Length 21.2, diam. 16, aperture 11.1 mm.; 6¾ whorls.

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" Length 23, diam. 18 mm.; 7 whorls " (*Baldwin*).

Hawaii: Palihoukapapa, on the Hamakua slope of Mauna Kea, at an elevation of 4000 ft., fossil in a deposit about a foot below the surface (Eugene Horner).

Amastra senilis BALDWIN, Nautilus, xvii, July, 1903, p. 35. —HENSHAW, Journ. of Malacology, xi, p. 63.

The largest Hawaiian *Amastra,* recalling *A. kauaiensis* in general contour, but with the thin texture and striate embryo of *A. melanosis* and its allies. Baldwin states that there is " a thick parietal callosity," but this is evidently only in old shells, as the parietal callus is quite thin in the cotypes which he sent for figuring. The species is most nearly related to *A. melanosis,* and is remarkable for its open umbilicus, as in *Cyclamastra.*

106. A. MELANOSIS (Newcomb). Pl. 47, figs. 1, 2, 6, 7, 9.

Shell dextral, thin, conically depressed; apex acute; whorls 5, rounded, the last inflated; suture well-impressed, aperture subrotund; lip simple, thin; columella straight, white, and terminating in a very oblique plait; color black. Length 8, diam. five-twentieths of an inch (*Newc.*).

Hawaii (Newcomb); Hamakua (Baldwin); Kukaiau (Thaanum).

Achatinella melanosis NEWC., P. Z. S., 1853, p. 144, pl. 23, fig. 41.

The typical form of *melanosis* as figured by Newcomb pl. 47, fig. 6) is more widely conic than any specimens we have seen. Probably the type colony has not been rediscovered. The locality is unknown, but probably the type came from somewhere in Hamakua district, north from Mauna Kea.

Specimens from Hamakua, received from Mr. Baldwin are figured, pl. 47, figs. 1, 2, 9. The embryonic whorls have a very fine sculpture of sharp, close, curved striæ. Later whorls have more oblique, irregular growth-lines, and are quite convex. Sometimes by the slow descent of the last whorl, a peripheral angle is disclosed on the penultimate, while in other shells it is covered. The last whorl is more

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or less strongly angular peripherally, and the surface especially on the base, has spiral grooves or sulci, sometimes very lightly impressed. The last whorl is covered with a yellow, glossy inner cuticle, exposed in front of the aperture, elsewhere concealed by a dull-brown outer cuticle with blackish streaks. The interior and columella are blue-white, the columellar fold small and very oblique, and the axis rather openly perforate.

Length 14, diam. 8 mm.; 5½ whorls.

Length 13, diam. 8 mm.; 5½ whorls.

At Kukaiau the shells collected by Mr. Thaanum are but weakly angular peripherally, and the epidermis, brown and somewhat streaked on the spire, becomes intensely black on the last whorl. Length 13, diam. 8 mm. (pl. 47, fig. 7).

Three smaller shells in Cooke collection (no. 2267) are narrower, with the peripheral angle very weak or wholly lacking on the last whorl. Length 11, diam. 6.6 mm.

Another lot (57713, A. N. S. P.) consists of small shells with the angle obsolete or wanting, and dull whitish or pinkish under the dull brown cuticle, having no glossy, yellow layer. These probably form a distinct subspecies, but the exact locality is unknown. Length 12, diam. 7.1 mm.

107. A. CONICA Baldwin. Pl. 47, fig. 8.

" Shell fossil, dextral, minutely perforated, thin, elongately conical, apex acute; surface sculptured with fine growth-lines, apical whorls radiately sulcated. Color of living shell unknown. Whorls 7, convex; suture well impressed. Aperture oblique, oval. Peristome simple, very thin. Columella terminating in a slightly developed fold. Length 15½, diam. 8 mm." (*Baldwin*).

Hawaii: Mana, district of Hamakua, fossil (H. W. Henshaw).

Amastra conica BALDWIN, Nautilus, xix, p. 137, 1906.

This species has about the contour of *A. henshawi*, from which it differs by its thinness, the *much more convex* and more numerous whorls, and the very finely but sharply striate embryonic whorls. The largest of several of the type lot sent

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by Mr. Baldwin measures, length 15.2, diam. 7.9, aperture 6.5 mm.; 6⅔ whorls. It differs from *A. melanosis* by its narrow contour and rounded last whorl, but is very closely related to *A. fossilis*. The columellar margin is more broadly reflexed than in the following recent forms. Above the suture an angulation is visible as far as the middle or even the end of the penultimate whorl. The following varieties also show this feature.

107a. Var. *gyrans* Hyatt, n. v. Pl. 47, figs. 3, 4.

Shell extremely thin, smaller than *A. conica*, the summit a trifle more slender. Pale-brown under a thin dull-brown cuticle, the colors showing through in the aperture. Columellar fold very small and oblique, axis perforate or rimate. Embryonic whorls convex, somewhat produced, very finely, sharply striate.

Length 14, diam. 7.1, aperture 6.5 mm.; 6 whorls.

Length 12.5, diam. 6.25, aperture 5 mm.; 6 whorls.

Hawaii: Types no. 2268, Cooke coll.

Although Mr. Baldwin expressed the opinion that *A. conica* would not be found living, a comparison of specimens shows that *gyrans* is practically only a somewhat smaller living form of the same species, if indeed it can be discriminated even varietally.

107b. Var. *kohalensis* n. v. Pl. 49, fig. 13.

The shell is thicker than var. *gyrans*, fleshy whitish under the cuticle, apex brown. The thin cuticle is yellow, copiously streaked with chestnut, the streaks rather narrow; aperture and parietal callus faintly flesh-tinted; columellar lamella very oblique and very low, suprasutural keel well developed as far as the front of the penultimate whorl. Length 15, diam. 7, aperture 5.5 mm.; 6⅓ whorls.

Kohala Mts. (D. Thaanum, no. 5158, communicated by Dr. C. M. Cooke).

This form resembles Newcomb's figure of *A. lineolata*, but the streaks are not in the lest zigzag. It may turn out that Newcomb's phrase refers to some slight irregularity due to wear; yet I do not feel justified in making this assumption.

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108. A. FOSSILIS Baldwin. Pl. 47, fig. 10.

" Shell fossil, dextral, minutely perforated, somewhat solid; elongately conical, apex rather acute; surface striated with somewhat irregular growth-lines; embryonic whorls under a lens exhibiting very delicate and regular sulcations. Color of living shell unknown. Whorls 7, slightly convex. Aperture oblique, ovate; peristome simple, very thin, columellar margin slightly expanded over the umbilicus; columella terminating in a flexuous thread-like plait. Length 18, diam. 9 mm." (*Baldwin*).

Hawaii: Palihoukapapa, 4 miles from Mana, on the Hamakua slope of Mauna Kea, elevation about 4000 ft., fossil in a deposit about a foot below the surface (Eugene Horner).

Amastra fossilis BALDWIN, Nautilus, xvii, July, 1903, p. 35.—HENSHAW, Journal of Malacology, xi, p. 63.

One of the types from the Baldwin collection is figured. The shell differs from *A. conica* by being wider below, more turrited, resembling some wide forms of *A. turritella* in contour. It is moreover somewhat malleate, in some examples. The embryonic whorls are worn, so that their sculpture is lost. Later whorls are rather convex and have rather coarse growth-wrinkles, and in the larger shell some irregular malleation on the last whorl. The columellar fold is small and oblique, and the axial perforation rather large and open.

Fig. 10. Length 17.21, diam. 9, aperture 7.25 mm.; 6⅓ whorls.

Length 15.3, diam. 9, aperture 6.9 mm.; 6 whorls.

This form may turn out to intergrade with *A. conica*.

Series of A. flavescens.

This series contains but two well-defined species, which are very close to typical *Amastrella* conchologically. Probably *A. luteola* Fér. (species no. 113) may prove to be a slender form of this series. It is to be looked for in northwestern Hawaii.

109. A. FLAVESCENS (Newcomb). Pl. 47, figs. 12, 13, 14, 17.

" Shell dextral, conical; whorls 6, slightly rounded; suture

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simple, well-impressed; striæ numerous, longitudinal and well-developed. Aperture semiovate; lip simple; columella short, with an oblique plaited tooth. Color of shell externally of a uniform light reddish-yellow, internally white or pale rose. Length 13, diam. six-twentieths of an inch " (*Newc.*).

Hawaii (Newcomb). Eastern Hawaii, from the northern slope of Mauna Kea at Hamakua, to the eastern (Olaa) and southeastern (Kau) slopes of Mauna Loa. Above Kukuihaele; rare in the deposit at Manu, and common living at about 2000 ft.; Laupahoehoe Gulch, 800 ft.; near Olaa, Puna district (Henshaw).

Achatinella flavescens NEWC., P. Z. S., 1853, p. 151, pl. 24, f. 62.—PFR., Monogr., iv, 553.—THWING, Occ. Pap., B. P. B. Mus., iii, no. 1, p. 178.—*Amastra flavescens* PSE., P. Z. S., 1869, p. 650.—HENSHAW, Journal of Malacology, xi, p. 63.—*Amastra saxicola* BALDWIN, Nautilus, xvii, July, 1903, p. 34.

The shell is imperforate or shortly rimate, with straightly conic spire. The whorls are all convex, the embryonic 2½ are glossy, almost *smooth,* marked with extremely faint, fine growth-lines only. The last whorl is generally quite noticeably swollen below the suture. The thin cuticle is yellowish except on the last half of the last whorl where it becomes chestnut, at least near the lip. On the spire the yellow tint fades to white at the summit. Under the cuticle the shell is white, or sometimes faintly ruddy. There is more or less lip-rib, of a pink or flesh tint. The columellar fold is strongly oblique. Length 15.5, diam. 8.1 to 8.5, aperture 7.1 mm.; 6 whorls. Specimens from Newcomb. The largest of the lot is 16.8 mm. long. Newcomb gives the length as 16.25 mm.

The definite localities for *flavescens* given above are based on specimens in U. S. Nat. Mus., collected by H. W. Henshaw. Specimens from a lot from near Olaa (no. 172935) vary as follows:

Length 17.2, diam. 8, aperture 7.2 mm.
Length 15.8, diam. 8.1, aperture 7.1 mm.
Length 14, diam. 7.8, aperture 6.7 mm.

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109a. Var. *saxicola* Baldwin. Pl. 47, figs. 11, 16.

A. saxicola Baldwin does not seem specifically separable from *A. flavescens*. Four specimens of the type lot from Baldwin's collection are before us, are a very light pinkish-brown tint, with the thin lip edged with pink within, fading inward. One of these is figured, fig. 16.

Length 17, diam. 9.2, aperture 7.5 mm.; 6½ whorls.

Length 16.9, diam. 9.2, aperture 7.3 mm.; 6⅓ whorls.

Length 16, diam. 9, aperture 7.2 mm.

The dimensions given by Baldwin were evidently taken from a much more oblong shell than those sent for figuring, but one of a set of 10 shells from H. W. Henshaw (no. 172937, U. S. Nat. Mus.) has the same ratio of diam. to length. Others agree with those from Baldwin, extreme examples measuring:

Fig. 11. Length 18, diam. 9, aperture 8 mm.; whorls 6½.

Length 15.3, diam. 9, aperture 7.2 mm.; whorls 6.

This lot is labeled: A. A. flow, Kahuku ranch, Kau, 2400 ft. alt.

Baldwin's description follows:

"*Amastra saxicola* n. sp. Shell dextral, imperforate, rather solid, elongately ovate-conic, apex subacute; surface lustreless, sculptured with delicate growth-lines; embryonic whorls smooth and polished. Color reddish-brown, tending to lighter shade on the middle whorls; apex pearly white; destitute of the usual fugacious epidermis of this genus. Whorls 7, slightly convex; suture well-impressed. Aperture ovate, a little oblique, pinkish within. Peristome simple, acute, not thickened within, extremities joined by a very thin, pinkish parietal callosity; columella white; flexuous, terminating in a moderately-developed lamellar plait. Length 20⅓, diam. 10 mm. Habitat: Kau, Island of Hawaii.

" This shell seems to live among and under rocks to an unusual degree. It is found on old lava flows attached to the under side of rocks, or in loose soil and trash at the base of bunch grass growing on lava flows. The locality is very arid " (*Baldwin*).

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109b. *A. flavescens henshawi* Baldwin. Pl. 47, fig. 15.

" Shell dextral, imperforate or subperforate, solid, ovately conical, apex subacute; surface lustreless, striated with somewhat irregular lines of growth; embryonic whorls under a lens showing very delicate radiating sulcations. Color varies from light to very dark brown, the upper whorls generally much darker than the body whorl; the lower whorls with traces of a deciduous, brown epidermis. Whorls 6, somewhat convex, the last one with a light carination at the periphery; suture well impressed. Aperture ovate, a little oblique, livid white within; peristome acute, slightly thickened within, extremities united with a thin, livid-white parietal callosity; columella white, flexuous, abruptly terminating in a thin lamellar plait. Length 18, diam. 10 mm." (*Baldwin*).

Hawaii: South Kona, in damp woods at the roots of ferns and nearly buried in trash, at altitudes of from 1,800 to 4,000 feet.

Amastra henshawi BALDWIN, Nautilus, xvii, July, 1903, p. 34.—HENSHAW, Journ. Malac. Soc., Lond., vi, p. 121.—*Achatinella henshawi* Baldwin, THWING, Occ. Pap., P. B. P. Mus., ii, no. 1, p. 179.

" We take pleasure in dedicating this shell to Prof. H. W. Henshaw, formerly of the Smithsonian Institution, Washington, D. C." (*Baldwin*).

A specimen of the original lot, received from Mr. Baldwin, is figured. These shells have the apex glossy, very faintly, finely striate, but nearly as smooth as in *A. flavescens*. The term " sulcations " used by Mr. Baldwin is misapplied. There is only the least trace of angulation at the periphery—not enough to mention had it not been for Mr. Baldwin's phrase. The aperture is oblique, white within, columellar fold small and oblique. Cuticle brownish-yellow, thin, the surface below it, exposed in front of the aperture, whitish or very pale yellow. Early whorls slightly olivaceous. The shell differs from *A. flavescens* chiefly by its slightly narrower contour, and may without violence be ranked as a form of *flavescens*. Mr. Thwing has expressed the opinion that they are identical. Length 16, diam. 7.9, aperture 7 mm.; 6 whorls.

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110. A. HAWAIIENSIS n. sp. Pl. 42, figs. 7, 8.

Shell imperforate, ovate-conic, thin but rather strong, white or faintly flesh-tinted under a thin, pale, yellowish-brown cuticle. Outlines of the spire straight, the embryonic whorls smooth, as in *A. flavescens;* following whorl strongly convex, with fine sculpture of growth-wrinkles. Last whorl inflated, short, often weakly subangular at the periphery, in front of the aperture. Aperture white; outer lip a little obtuse but not thickened within. Columellar fold moderately strong; parietal callus distinct or rather thick, dirty whitish.

Length 11.8, diam. 8, aperture 6.5 mm.; 5½ whorls.

Length 12, diam. 7.9, aperture 6 mm.; 5½ whorls.

Hawaii: Waimanu, in the northeastern part of the island (Baldwin). Cotypes, no. 105540, coll. A. N. S. P., and in the Boston Society and Baldwin's collections.

This species, while closely related to *A. flavescens,* is perfectly distinct by its shortened form. In old shells the sinus below the columellar fold is preceded by a plicate area, showing former positions of the margin.

Mr. Baldwin states that this is the only true *Amastra* ever found on plants. According to Mr. Henshaw the shells were taken in the deep forest at an altitude of 2550 ft. All were found either on the Olona or near them on the ground. This plant, *Touchardia latifolia,* is generally four to six feet high with large leaves but slender stems. It is the favorite resort of *Laminella. L. alexandri* is about the only exception, it being found at a much higher altitude than where the olona grows. Mr. Henshaw thinks the *Amastra* may have a wide range at about the elevation of 2500 ft. In a subsequent letter he states that 85 per cent of the shells were found on the olona and ferns beneath. They affect ferns that are partly dead and also partially dead leaves found upon the ferns, a few varieties found upon the ground beneath the dead leaves.

AMASTRÆ OF UNKNOWN HABITAT.

An examination of the type specimens of the following species would probably reveal their approximate habitats to

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an expert in Achatinellidæ, but the published descriptions are inconclusive.

111. A. AMICTA Smith. Pl. 43, fig. 10.

"Shell dextral, thin, ovate-conic, subperforate, hardly glossy, rugosely striate with growth-lines; purplish beneath an olivaceous, rough epidermis. Whorls 6, convex, suture somewhat constricted but not margined. Aperture small, slightly over one-third the total length, purplish within; peristome thin. Columella nearly straight, provided with a small oblique fold. Length 13, diam. 6½ mm." (*Smith*).

Sandwich Is. (Brit. Mus.).

Amastra amicta SMITH, P. Z. S., 1873, p. 86, pl. 10, f. 20.—SYKES, Fauna Hawaiiensis, p. 333.

"This species is remarkable for the roughness of the epidermis, which is generally worn away from the front of the body-whorl near the aperture" (*Smith*).

"It appears to me quite distinct" [from *petricola*] (*Sykes*).

Unknown to us except by the original description and figure, here reproduced. *Cf. A. affinis* and *A. nana.*

112. A. LINEOLATA Newcomb. Pl. 45, fig. 9.

Shell dextral, elongate-turrited, shining, covered with a yellowish epidermis; whorls 6, ventricose, last one thickly marked with longitudinal umber-colored zigzag lines; suture simple; aperture ovate; columella with an oblique plaited tooth. Length .5, breadth .22 inch (*Newcomb*).

Maui or Hawaii.

Achatinella lineolata NEWC., Ann. Lyc. Nat. Hist. of N. Y., vi, May, 1853, p. 29 (Maui); P. Z. S., 1853, p. 140, pl. 23, f. 29 (Hawaii).—*Amastra l.,* PEASE, P. Z. S., 1869, p. 650.

Newcomb gave the locality *Maui* in his first paper, *Hawaii* in the second. The characters of the shell so far as made known, seem not unlike the *affinis* series of Maui, and not like any Hawaiian species, in which zigzag lines are unknown. We do not know that any subsequent investigator has met with the species, which is thus imperfectly known and of uncertain position. Hartman considered it a *Leptachatina;* but

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the coloration and acute apex are against this view. Newcomb's figure, which we copy, does not show the zigzag lineolation described, probably because of its small size; but it has a marked resemblance to the small recent form of *A. conica* from Hawaii. Whether drawn from a Mauian or a Hawaiian shell we do not know. It measures about 13.5 mm. long, 7 wide, while the measurements of Newcomb's type were given as about 12.5x5.5 mm. *Cf. A. conica kohalensis.*

Dr. C. Montague Cooke, in a recent letter writes that "Newcomb, in a letter written to Garrett, July 8, 1854, gives the exact locality of this species (with *melanosis*) as 'near Kunneys.' This is now the Paris place at South Kona, Hawaii. Newcomb's original material was collected by Dr. Smith. In the same letter Newcomb states that *A. remyi* is from Waimea, Hawaii. No doubt that a number of Newcomb's localities are wrong—at least it seems so to me in working over his species."

113. A. LUTEOLA (Férussac). Pl. 35, fig. 6.

"Shell dextral, elongate, striatulate; white with a fugacious buff epidermis; whorls 5-6 ? the last scarcely carinate; suture not duplicate; aperture ovate-elongate; columella white, arcuate; umbilical crevice not distinct. It was found by M. Gaudichaud. It is probable that it lives on the Marianne Is. We have seen but one example without the tip" (*Fér.*).

Helix luteola Fér. Voy. de l'Uranie, etc., 1824, p. 480; Hist., pl. 155, f. 12.—*A. luteola* DESH., in Fér., Hist., p. 195. —*Laminella lutcola* Fér. (*sic*) HARTMAN, Proc. A. N. S., Phila., 1888, p. 42.

H. luteola Fér., has been supposed to be a form of *A. turritella,* but the figures show a shell with the last whorl more oblong. Newcomb was unable to trace the type in the Paris collection, and it is unknown to Hawaiian collectors so far as we know. The original description is translated above. If the figure in the Histoire was taken from the type specimen, which we have no reason to doubt, the apex was restored. It is copied in our pl. 35, fig. 6.

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The *Uranie* visited Hawaii in August, 1819. Some time was spent in Kailua Bay, near the middle of the west coast, where Gaimard, the surgeon-naturalist, explored the neighborhood. A second stop was made further up the coast at Kawaihae Harbor in Kohala district. Whether *Amastra* extends down the west coast to Kailua or Mt. Hualalai is not known, but it certainly occurs in the Kohala mountains. I suspect that *A. luteola* was procured in that region. It should be looked for on the western slopes of the Kohala Mts., towards Kawaihae.

I cannot endorse Borcherding's contention that *luteola* is a dextral *Laminella citrina*. The shape of the shell is entirely different. Moreover, the *Uranie* did not visit Molokai, but only Hawaii and Oahu.

114. A. PEASEI Smith. Pl. 49, fig. 11.

" Shell dextral, globosely ovate-conic, subperforate, a little glossy, lightly striated with lines of growth, covered with a very thin epidermis. Whorls 6, the first four reddish-brown, a little convex, penultimate whorl large, inflated, and paler like the last whorl; the spire passes abruptly into a cone above the penult. whorl. Suture simple. Aperture small, not as long as the spire, subquadrate, reddish inside. Peristome thin; columella straight, slightly reflexed, nearly covering the small umbilical crevice, provided with a thin. subbasal fold, and joined to the lip by a very thin callus. Length 17, diam. 10 mm.

" Var. *b*. Spire almost straightly conic " (*Smith*).

Sandwich Islands (Gulick). Type in British Museum.

Amastra peasei SMITH, P. Z. S., 1873, p. 86, pl. 10, f. 13.—*A. peasii* HARTMAN, Proc. A. N. S., Phila., 1888, p. 48.

" Remarkable for the large size of the penultimate whorl " (*Smith*).

We have not seen this species. It may be a Lanai shell related to *A. aurostoma*, but it also seems not unlike *A. inflata* of Oahu.

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Genus LAMINELLA Pfeiffer.

Laminella Pfr., Malakozoologische Blätter, i, June, 1854, p. 126 (no type selected).—Von Martens, Die Heliceen, 1860, p. 250 (type *Achatinella gravida* Fér.).—Pease, P. Z. S., 1869, p. 648.—Gulick, P. Z. S., 1873, p. 90, same type.—Sykes, Fauna Hawaiiensis, p. 348, same type.—Borcherding, Zoologica, xix, Heft 48, p. 84 (type *L. citrina* Migh.).

Shell pyramidal or ovate-conic, almost always sinistral and perforate, smooth or nearly so; yellow, whitish or pink, usually striped longitudinally or dotted with black; columella straight, often with accessory folds above the columellar lamella. Embryonic shell with the first ½ to 1½ whorls smooth, the rest more or less costate or grooved longitudinally, columellar with no columellar lamella or a very small one. Radula substantially as in *Amastra*. Viviparous; arboreal.

Type *L. gravida* Fér. Distribution, Oahu, Molokai, Maui and Lanai.

Unlike the Amastras, nearly all Laminellas are sinistral. *L. concinna* seems to be indifferently dextral or sinistral. *L. venusta orientalis* is dextral so far as known. Dextral specimens have also been noted in *L. citrina* and *L. bulbosa*.

"*Laminella* lives on bushes, vines and ferns. The most common stations are the olona (*Touchardia latifolia*) and ieie (*Freycinetia arnotti*). It is usually found in rather damp, dark, mountain ravines" (C. M. Cooke).

Nomenclature and taxonomic history.—Pfeiffer's original list of species under the then new section *Laminella* seems now rather heterogeneous; but at the time it was proposed the group was a natural and very judicious one, providing a place in the system for the *Laminellæ* and *Amastræ*—groups now known to be intimately related, and by some authors united into one genus. The first species of Pfeiffer's list is *A. marmorata* Gld., of which he writes "*mir noch unbekannt*"; the second species is *A. gravida*, which von Martens in 1860 selected as the type, a course followed by Gulick and Sykes. Borcherding's selection of *A. citrina* as type of *Laminella* was therefore nugatory. Nearly a year after the publication of Laminella, H. and A. Adams separated from

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it part of the species to form their new group *Amastra*. The lists of species given by von Martens, Adams and Pease show that their views of the groups dealt with were hazy, in contrast with Pfeiffer's clear vision. Von Martens placed the yellow Laminellas in *Newcombia*, his *Laminella* being composed of *L. gravida* and most of the *Amastræ;* other *Amastræ* he included in *Leptachatina*. Pease was the first to give *Laminella* generic rank. Sykes has herded several sinistral Amastræ among his Laminellæ; but Baldwin, in his Catalogue of 1893, eliminated all Amastroid forms, limiting the group exactly as in the present work.

ORIGIN.—The ancestral stock of *Laminella* probably had shells marked with oblique or angulated dark lines or stripes on a yellow or pale ground. This inference rests upon the fact that the pattern is common to almost every species, if not in the adult, then on the early neanic or last embryonic whorls. The exceptions are a few species or individuals in which no pattern is developed. Part of the Amastræ of Molokai, Maui and Lanai have a similar pattern. They probably descended from the same *Amastrella* stock, though a tendency to zebra-striping in various totally diverse Achatinellid groups of Molokai-Maui must be conceded. Certain of the angular-striped Amastræ (the *biplicata* group) have a similar tendency to duplicate the columellar fold. Whether the color-pattern and columellar structure were expressed in the common ancestors of *Laminella* and *Amastra* is somewhat doubtful. They may have been developed orthogenetically. *Cf.* also *Partulina, Newcombia* and *Perdicella.*

The theory that *Laminella* had its origin in the Molokai-Maui-Lanai area has its basis in two facts: In this area the genus has many diversified species, while in Oahu there are but three species, these belonging to one of the Molokai-Maui-Lanai groups. In the eastern islands *Laminella* has its very characteristic color-pattern in common with Amastræ special to the same islands, suggesting the inference of a common ancestry, while in Oahu the *Laminella* species stand conspicuously apart from all other snails of the island.

COLOR-PATTERNS.—The color-pattern in *Laminella* is usu-

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ally of highly " accelerated " type, neanic or adult patterns appearing in the embryonic stage. In forms which have not undergone degeneration of the color-pattern, the sequence in ontogeny is about as follows: (1) on the second embryonic whorl longitudinal streaks appear; (2) on the third whorl near the end of the embryonic stage, these are replaced by a few well-separated, longitudinally-protractive stripes, pl. 56, figs. 6, 8, *L. picta;* (3) on the early neanic whorls the stripes are closer, vary in direction, and often become angulated; (4) on the later neanic and last whorl the stripes become zigzag, or anastomose in various patterns; (5) on the last part of the last whorl, especially basally, the dark stripes become coalescent, producing a more or less uniform blackish color.

In more accelerated species the successive patterns may appear earlier; in less accelerated forms, patterns (2), (3) or (4) may persist (as in *L. a. duoplicata*), later patterns not appearing; various stages may be left out; or degenerative change may set in at any stage, the stripes breaking into dots, as in *L. semivenulata,* pl. 56, fig. 7, or disappearing entirely. That such degeneration of pattern is secondary is evident from the fact that the disappearance is progressive from the last towards the earlier stages, as in *L. helvina, L. semivestita,* etc. *L. concinna circumcincta* has a highly evolved color-pattern, in which the primitive longitudinal stripes have been broadly interrupted, their separated remnants coalescing spirally to form encircling bands. Some specimens of *L. citrina semivenulata* show a tendency towards a similar pattern.

I look upon *L. picta* and its allies as the more primitive forms of the genus, approaching nearest to the Amastræ of the same islands, though it is evident that all the Laminellæ are rather evolved forms. Professor Hyatt held *L. gravida* to be the most primitive *Laminella,* apparently on account of its Amastroid shape and cuticle. This species seems to me to be not primitive but highly evolved. The zigzag-striped stage is confined to the early neanic whorls (pl. 56, fig. 1), while the later neanic and last whorl have a uniform, dark cuticle

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(when not deciduous), such as appears only in the latest stage—the latter part of the last whorl—of the less evolved forms. Such a highly accelerated color-pattern can hardly characterize a primitive form.

No phylogeny of the species can be suggested, in the absence of fossil or retarded recent forms, but the principal forms seem to be related somewhat thus.

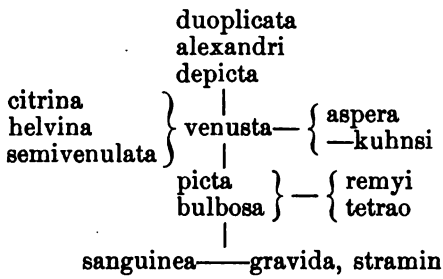

Diagram to show the affinities of Laminellæ, picta being considered the most primitive form.

While the *gravida* and *sanguinea* groups of Oahu seem very distinct, yet both are related to the *picta* group, which has both white and pink-mouthed forms.

Species of Oahu.

The Oahuan Laminellas are isolated, having been separated for a long period from the other forms, among which they seem nearest to *L. picta* and *bulbosa* of Maui and *remyi* of Lanai. Two species are confined to the eastern or Koolau range, the other inhabiting the western part of the Koolau range and the Waianæ mountains.

a. Shell ovate with light ground-color.

b. Diam. more than ½ length; cream-white, partly covered with deciduous dark cuticle. 19x11 to 28x15 mm. *L. gravida,* No. 1.

*b*¹. Pale flesh or pink, cuticle nearly all lost. *L. g. suffusa,* No. 1*a*.

*b*². White or pale yellow, without noticeable dark cuticle; more turrite; aperture not quite ½ length. *L. straminea,* No. 2.

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a^1. Shell turrite, with angular black stripes on a reddish ground. *L. sanguinea*, No. 3.

1. L. GRAVIDA (Férussac). Pl. 55, figs. 1, 2, 3, 4.

"Shell sinistral, inflated, finely striate; spire conic, acute; epidermis brown, fugacious; whorls 5½; suture not duplicated; aperture semilunate, white; peristome thickened within; columella white, provided with a distinct rib; an unbilical fissure. This species, which also inhabits the Sandwich Islands, has especial resemblance to the preceding [*vulpina*], but it is more swollen, the spire is more pointed and the sutures are simple. The columella affords more distinctly an elevated rib, revolving around it and penetrating into the shell." (*Fér.*)

Oahu: Niu to Kalihi (Baldwin); Waialae Nui, Palolo, Manoa, Tantalus, Nuuanu, Kalihi, Moanalua (Cooke and Gulick).

Helix gravida FÉR., Voyage autour du Monde de l'Uranie et la Physicienne pendant les années 1817-1820, Zoologie, p. 478, pl. 68, figs. 4, 5 (1824), with *b. gracilis*, undefined; Histoire, etc., pl. 155, f. 3 (cuticle restored!).—*Bulimus gravidus* PFR., Symbolæ ad Hist. Heliceorum, i, p. 82; ii, p. 115.—*Achatinella gravida* PFR., P. Z. S., 1845, p. 90; Monographia Hel. Viv., ii, p. 238; iii, 456; iv, 546; vi, 178.—NEWCOMB, Ann. Lyc. N. H. of N. Y., vi, p. 307 (animal).—THWING, Occ. Pap. B. P. B. Museum, iii, p. 126, pl. 2, f. 23.—*Amastra* (*Laminella*) *gravida* Fér., SYKES, Fauna Hawaiiensis, p. 349.—*Achatinella suffusa* REEVE, Conch. Icon., vi, April, 1850, pl. 2, f. 11.—*A. gravida* var. *concolor* MARTENS, Die Heliceen, 1860, p. 250, new name for *suffusa* Rve.—*Achatinella dimondi* C. B. ADAMS, Ann. Lyc. N. H. of N. Y., v, 1850, p. 42; Contrib. to Conch., no. 8, p. 126, with var. *lata*, p. 127.

Férussac's original specimens were doubtless taken in the vicinity, while the *Uranie* lay in Honolulu Harbor. Palolo valley may be considered the type locality.

The ovate-pyramidal shell is solid, cream-white or towards the base brown-tinted, apex flesh-tinted. It is more or less covered with dark cuticle, which remains in patches and

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shreds, or may be almost wholly wanting. The spire has straight outlines and nearly flat whorls. The apex is conic; first half-whorl smooth; then longitudinal folds or ribs appear. On the second whorl these ribs shorten, usually not reaching below the middle of the exposed surface of the whorl; they become finer, and on the third whorl become merely growth-striæ. The whole embryonic stage comprises about three whorls (pl. 56, fig. 1). Subsequent whorls have fine growth-striæ only. On the early neanic whorls the thin, olivaceous cuticle is streaked, and mottled with triangular light spots, or it is pale with ragged zigzag or angulated dark lines (lower whorl in pl. 56, fig. 1). This pattern usually extends to the penultimate or last whorl, which has a denser, blackish cuticle, retained in fragments, very rarely almost continuous, or sometimes wanting. The aperture is very oblique, and typically almost white. Lip thin, usually dark at the edge. Columellar lamella thin and ascending steeply.

Length 25.5, diam. 14.3, aperture 12 mm.; 7 whorls (Palolo).

Length 28.3, diam. 15, aperture 14 mm.; 7 whorls (Nuuanu).

Length 23, diam. 15, aperture 13 mm.; 6½ whorls (Nuuanu).

Length 20, diam. 12 mm.; 6½ whorls (Nuuanu).

Length 19, diam. 11 mm.; 6⅓ whorls (Tantalus).

The contour varies a good deal in the same colonies. Férussac's *gracilis* and C. B. Adams' *lata* pertaining merely to rather slender and wide individuals respectively, and have no racial standing. *A. dimondi* of Adams is identical with typical *L. gravida*.

1*a*. Form *suffusa* Rve., pl. 55, figs. 5-8. In some colonies the shells have a pale flesh or pinkish tint, early whorls yellowish, the interior pale pink or fleshy; dark cuticle usually almost all lost. Palolo, Tantalus, Nuuanu (figs. 5-7), Kalihi, Moanalua.

Fig. 8 is a copy of Reeve's figure. Figs. 5 and 6 are transitional to *gravida*.

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2. L. STRAMINEA (Reeve). Pl. 55, figs. 10, 11.

" Shell acuminately oblong, sinistral, whorls convex, obliquely striated, columella strongly twist-plaited; straw colored, unspotted. Sandwich Islands " (*Reeve*).

" Animal of a uniform light flesh color, oral aperture margined with a line of orange " (*Newcomb*).

Oahu: Waialae nui (Cooke); Palolo, Pauoa (Gulick); Makiki, Tantalus, Nuuanu (Cooke). Found almost entirely on the olana, a broad-leaved bush, in sheltered, shady places (Gulick).

Achatinella straminea RVE., Conch. Icon., vi, pl. 5, f. 38 (April, 1850).—PFR., Monogr., iii, 463.—BALDWIN, Catalogue, p. 8.—NEWCOMB, Ann. Lyc. N. H. of N. Y., vi, p. 318, living animal.

More turrited and slender than *gravida,* the embryonic whorls not costulate, and the shell retaining very little dark cuticle or none at any stage of growth.

The embryonic whorls are finely, irregularly striate, but not ribbed. The *very pale yellow* or nearly white cuticle is somewhat glossy when unworn, and rarely shows a few minute flecks of dark cuticle on the last whorl. The axis is generally imperforate. *Interior white,* the outer lip strengthened by a rather strong internal rib in many adult shells. The steeply ascending columellar lamella is rather strong. The last whorl is sometimes weakly angular.

Length 23, diam. 11.5, aperture 9.8 mm.; 6⅔ whorls (Palolo).

Length 22.7, diam. 12.7, aperture 10.5 mm.; 6¾ whorls (Tantalus).

Fig. 10. Length 24, diam. 12.6, aperture 11 mm.; 7 whorls (Tantalus).

Fig. 11. Length 22, diam. 10.8 mm. (Pauoa).

While it is closely related to *L. gravida,* yet there seems to be no connecting specimens between the two species. *L. gravida* is the more abundant and widely spread species.

In the Cooke collection there is a set of four specimens, no. 1778, said to be from Waianae. They are rather long, closely

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marked with shreds of cuticle over a dull cream-whitish ground. Interior pinkish-white, with a rose or purplish band within the lip, columella of the same color.

✓ 3. L. SANGUINEA (Newcomb). Pl. 55, figs. 9, 12 to 16.

Shell acuminately oblong; whorls 7, convex below, planoconvex above; suture distinctly marked; aperture subovate; columella armed with a twisted plicate tooth; lip simple. Color of shell from roseate to sanguineous, thickly covered with black lineations forming chain-work and zigzag markings on the three lower whorls; denuded of epidermis above; apex mamillate and black. Length eighteen-twentieths, diam. eight-twentieths inch (*Newc.*).

Animal as long as the shell; anterior superior portion a dark brown, with tentacles of the same color; posteriorly cut up into squares and other geometrical figures by light-colored lines. Mantle light flesh color; bottom of foot light-green (*Newcomb*).

Oahu, western range: Lihue (Newcomb); Waianae (Cooke, Baldwin). Interior of Koolau range: Kawailoa (Perkins), Helemano (Gulick, Perkins). Wahiawa, Kalaikoa, Ahonui (Gulick); and on the ocean slope in Kahana valley (Cooke).

Achatinella sanguinea NEWC., P. Z. S., 1853, p. 135, pl. 22, f. 15; Ann. Lyc. N. H. of N. Y., vi, 326 (animal).—PFR., Monogr., iv, 547.—BALDWIN, Catal., p. 8.—THWING, Occ. Papers, B. P. B. Mus., iii, p. 127, pl. 2, f. 24.—*Amastra* (*Laminella*) *sanguinea* Newc., SYKES, Fauna Hawaiiensis, p. 351.—*Achatinella ferussaci* PFR. ["*Fernsfaci*" in some copies, according to Pfr.] P. Z. S., 1855, p. 203; Monographia, iv, 546.—*Laminella sanguinea* Nc., GULICK, Evolution, Racial and Habitudinal, p. 38, pl. 1, f. 6 (Helemano).

In embryonic shells of 3½ whorls, length 5 to 5.6 mm., the first whorl is flesh-colored, the rest pale-yellow. The first whorl is glossy and shows very fine, weak growth-striæ. On the next whorl the striæ become strong and arcuate; and on the third whorl there are also low ribs, sculptured by the striæ. The periphery at this and earlier stages is angular and the base nearly smooth. Axis is narrowly perforate.

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Fig. 5 is from a Wahiawa shell, fig. 4 from a slightly older Ahonui shell, plate 56.

The embryonic whorls but slightly convex with non-impressed sutures, and very finely striate, reminding one forcibly of *Amastra turritella,* some forms of which have much the same contour. The last 3 or 4 whorls have, on a red ground, angular, zigzag, black streaks, sometimes separate, sometimes enmeshed, forming varied patterns, as shown in the figures. The outlines of the spire are always concave. The columellar lamella is strong and enters subhorizontally.

"In adult shells the protoconch and part of first volution are dark and have a glassy, smooth aspect. This changes on the second and third whorls to opaque purple or ashen, and fine striæ of growth appear. Dark blotches or longitudinal bars appear in many shells before this, even on the second or third volution, but these are straight, coincide with the growth-bands of the shells, and are often discontinued on the latter part of third or first part of fourth volution. These must, however, be reckoned as the forerunners of the zigzag pattern of the later stage, because in some shells they are not discontinued but pass into the zigzag lines of the fourth volution, and in some examples a zigzag form is assumed by isolated bars in the midst of the straight ones. A faint pink hue comes in usually on the latter part of the fourth volution, and at about the same time the black zigzag markings of the later stages begin to make their appearance with regularity. The color deepens into a pinkish red on the sixth volution, and the zigzag markings become broader; on the seventh volution the zigzags usually enmesh, and near the aperture, in old shells, form a black periostracum. The aperture is usually deep pink with a dark border; columella similar with a white subhorizontally entering tooth and dark reflected umbilical margin.

"In a living condition this shell is covered by a vegetable growth, apparently an alga, that entirely covers the shell except where worn off or kept away by friction in front of the aperture. No part of the elaborate pattern and brilliant color therefore is visible in the living animal. Each apical

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volution is convex but the increase by growth may vary from a straight spiral to one with concave sides, the last volution is as a rule gibbous but may as in one shell, no. 1042 Gul. coll., from Ahonui, verge on the subangular.

"The columella varies excessively in one large shell, no. 1042 Gul. coll., from Ahonui, it is widely open and the aspect of the base is quite distinct from that of the majority of the forms in which it has long narrow elongated perforations. In a certain number of shells—a limited number—it may be almost closed" (*Hyatt*).

The ground-color varies in tint, and in a few examples becomes nearly white. There is a tendency to form a second and even a third columellar fold, as in *Amastra turritella,* but in an insignificant proportion of the shells examined, and not restricted to those of any special locality. Although this species ranges across the island, from Waianae valley on the southwest to Kahana on the northeast, we note no tendency towards local or racial differentiation. Specimens from various places measure:

Length 18.5, diam. 10 mm. (Waianae).
Length 17.5, diam. 10.3 mm. (Waianae).
Length 21.3, diam. 10 mm. (Helemano).
Length 21, diam. 11 mm. (Helemano).
Length 22, diam. 11 mm. (Wahiawa).
Length 19, diam. 9.8 mm. (Wahiawa).
Length 22.3, diam. 11.5 mm. (Ahonui).
Length 21.5, diam. 11.3 mm. (Kahana).

L. sanguinea has very much the same distribution as *Amastra spirizona,* including *nigrolabris.* Whether it originally belonged to the Waianae or to the Koolau range is undetermined.

A. ferussaci Pfr. was based upon a shell which had lost the dark markings, either artificially or by weathering.

Mr. Oleson reports that there are two varieties in Palolo valley, the rose-colored which is found in a little offshoot from the main valley and the paler-colored ones are found in the main valley itself. Their habitat is uniformly on a single plant, the olona, having large succulent leaves, growing

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from 2-4 feet high, commonly about 2 feet. The bark is used for twine, after being properly prepared by the natives. It always grows in damp places.

A peculiarity about these shells is that they will drop from the leaves at the least disturbance. Mr. Oleson has never found the living shells on the ground when the plant has not been disturbed. It is a very prolific shell, and is generally in great numbers.

Species of Lanai.

The species of Lanai are related to the *picta* group of Maui, and in a much smaller degree to Oahuan forms. *L. concinna* is a rather isolated species.

a. Small shells, less than 10 mm. long; ovate, yellow, sometimes with black bands; whorls convex.
L. concinna, no. 6.

*a*¹. Larger shells, with network of angular black lines on a pale ground.

b. Pale buff with a rose band below suture; 18.5x11 to 14x9.5 mm. *L. tetrao*, no. 4.

*b*¹. Narrower, diam. about ½ length.

c. Somewhat turrite; early whorls smooth.
L. t. gracilior, no. 4*a*.

*c*¹. Ovate, third whorl costulate. *L. remyi*, no. 5.

4. L. TETRAO (Newc.). Pl. 54, figs. 1-7.

Shell subperforate, sinistral, globose-conic, pale, broadly banded with red below the suture, all over densely reticulated with greenish-brown epidermis; spire conic, rather acute. Whorls 6½, the upper ones flat, the rest very convex; last whorl globose, a little shorter than the spire. Aperture oblique, semioval, white within; columellar fold laminiform, somewhat oblique; peristome simple, unexpanded, acute, the columellar margin roseate, somewhat free. Length 16, diam. 8.5 mm. (*Pfr.*).

" Animal tessellated above with brown and white; mantle dirty yellow; bottom of foot same color margined with white; tentacles light-brown " (*Newc.*).

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Lanai (Newcomb); behind Koela (Perkins).

Achatinella tetrao NEWC., Proc. Boston Soc. N. H., v. 1855, p. 219; P. Z. S., 1854, p. 311 (animal); Ann. Lyc. N. H. of N. Y., vi, p. 334; Amer. Journ. of Conch., ii, p. 214, pl. 13, figs. 11, 12 (shell).—PFR., P. Z. S., 1855, p. 207 (1856); Monogr., iv, 547.—THWING, Occ. Pap. B. P. B. Mus., iii, p. 131, pl. 3, f. 1.—*Amastra* (*Laminella*) *tetrao* SYKES, Fauna Hawaiiensis, p. 352.—*Laminella tetrao* Nc., GULICK, Evolution Racial and Habitudinal, 1905, p. 38, pl. 1, f. 8.

The apex is somewhat more acute than usual. The first half-whorl is smooth; then weak longitudinal ribs begin, continuing for about two whorls; but in some shells they are very weak, hardly noticeable as ribs. Subsequent whorls are lusterless and marked with growth-lines only. The dark markings often are visible in adults on the second whorl, form a more or less dense network over the later whorls, and on the last part of the last whorl they often become coalescent into a nearly uniform blackness. The ground-color is usually pale buff, the embryonic whorls, a band below the suture and the columella rose, the interior more or less roseate. Exceptionally the rose color is altogether wanting, the apex yellowish, and the mouth white. Mr. Sykes notes that in the series collected by Perkins the ground-color varies; "shades of crimson or rich orange predominate, but occasionally the color is confined to a band below the suture, the rest of the shell being whitish." The columellar lamella is strong and less steeply ascending than usual in Laminella. In one specimen two small folds were noticed above it.

Length 17.2, diam. 11.2, aperture 8 mm.; 6½ whorls.

Length 18.5, diam. 11, aperture 8 mm.; 6½ whorls.

Length 17.2, diam. 10 mm.

Length 14, diam. 9.5 mm.

L. tetrao is closely related to the West Mauian *L. picta*, from which it differs chiefly in the more copious marking, producing a denser reticulation; also in the prevalence of rose color below the suture.

Several embryonic shells washed out of one of the adult shells figured, show that the coloration is greatly accelerated,

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appearing on the first whorl. Dark streaks begin with the second half-whorl in two, with the third fourth in another shell. The streaks are faint at first, dark and close on the second whorl; on the first and second whorls they are not in the least zigzag, but run with growth-lines. Angular figures appear on the third whorl. The earlier streaks are lost by wear in adult shells. Embryos of three whorls (pl. 56, fig. 2) have a small columellar lamella. At the two-whorled stage there is merely a sinuosity of the columella. Axis perforate.

4a. *L. tetrao gracilior* n. var. Pl. 54, fig. 8.

Among specimens in the Swift collection (A. N. S. P.), there is one extremely slender shell which approaches *L. remyi* in contour, but the early whorls are smoother, as in *tetrao*. Whether this is a local race or only an individual mutation we cannot tell. Length 15.5, diam. 8, aperture 6.1 mm.; 6½ whorls.

5. L. REMYI (Newcomb). Pl. 54, fig. 9.

Shell acuminately elongate, striæ numerous, well-defined, obliquely longitudinal; whorls 7, rounded, minutely margined above or plain; suture rather deep; aperture subovate; columella slightly callous, with a terminal lamellar plait; color salmon, painted with numerous zigzag black lines continuous from the summit to the base of the shell; lip margined within with reddish-purple. Length fourteen-twentieths, diam. six-twentieths inch (*Newc.*).

Lanai (Newcomb). Type in Newcomb coll., Cornell University Mus.; mountains behind Koela (Thwing).

Achatinella remyi NEWC., Ann. Lyc. Nat. Hist. of N. Y., vi, October, 1855, p. 146; Amer. Journ. of Conch., ii, p. 215, pl. 13, f. 13.—PFR., P. Z. S., 1855, p. 207; Monogr., vi, 178.—THWING, Occ. Pap. Bishop Mus., iii, no. 1, p. 130.

A very rare species, here figured from a specimen received from Newcomb. It is closely related to *L. tetrao,* but differs by the much more slender contour and especially by the more rugose third and fourth whorls. The aperture and last whorl are longer than in *L. tetrao gracilior.*

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Borcherding has added *remyi* to the Molokai fauna by an incorrect identification of specimens of *venusta* or *depicta*. The Lanaian species is not closely related to any Molokai form.

The shell is very pale buff, with some pink suffusion on the last whorl and the embryonic whorls. The first half-whorl is smooth, convex and uniform pinkish-brown; next whorl streaked, flattened and unevenly, rather weakly costate; on part of the third whorl the costation or corrugation is stronger, more or less irregular, after that weakening. The last whorl is very finely striatulate. There are reddish streaks between the ribs on the embryonic whorls; near the end of the third whorl these give place to a few widely-spaced oblique blackish stripes; after which the angular, zigzag or netted pattern begins. This pattern is essentially like that of *L. tetrao*. The interior of the aperture and the columella are pink; columellar lamella simple, steeply ascending. Perforation minute, or even closed. Length 14, diam. 7.25, aperture 6.3 mm.; fully 6 whorls.

6. L. CONCINNA (Newcomb). Pl. 54, figs. 10, 11.

"Shell dextrorsal, umbilicated, longitudinally very finely striated rather shining; whorls 6, convex; suture impressed; aperture ovate; columella short, straight, the margin reflexed, furnished anteriorly with a spiral plait; outer lip simple, acute; color pale yellow, the uppermost whorls rosy (*Newcomb*).

Lanai (Newcomb); Koela side of highest point; side opposite Koela, and near Koela at 3,000 ft. (Perkins).

Achatinella concinna NEWC., P. Z. S., 1853, p. 157, pl. 24, fig. 79.—PFR., Monogr., iv, 536.—THWING, Occ. Pap. B. P. B. Mus., iii, p. 131, pl. 3, f. 2.—*Amastra* (*Laminella*) *concinna* Newc., SYKES, Fauna Hawaiiensis, p. 348.

This small yellow or olivaceous-yellow shell is very distinct from all other species. It may be either dextral or sinistral in the same colony.

The embryonic whorls are smooth and convex, the rest strongly convex and weakly striatulate. Last two whorls

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covered with a pale or rather deep yellow cuticle, the earlier whorls denuded; first two pale yellow, the next faintly pink in a specimen received from Newcomb (fig. 10). In other shells the embryonic whorls are very pale yellow, and in one lot the first three whorls are dull cadmium yellow. The interior and columella are white. Columella triangularly reflexed, convex and calloused, as usual in Laminella. Columellar lamella rather small, steeply ascending; above it there is the weak trace of a fold. Axis perforate. Length 9.8, diam. 6, aperture 4.5 mm.; 5½ whorls (pl. 54, fig. 10, from Newcomb).

In a lot of 4 shells collected by Mr. Thaanum, 3 are sinistral, 1 dextral. Two have a strong, callous fold above the columellar lamella, and three are imperforate. The spire is longer than in the shells from Newcomb. Length 11.2, diam. 6.1, aperture 4.7 mm.; 5½ whorls (pl. 54, fig. 11).

Color-var. *circumcincta* Dall, n. var. Pl. 54, figs. 12, 13. Last whorl having blackish bands; a narrow one below the suture, a wide band above the periphery and a narrow one below it, the middle band sometimes wanting, upper band or bands ascending on the penult. whorl.

This form occurs in some colonies of the one-colored *concinna*, and its characters are probably not yet of racial significance. I have retained the collection name in order to call attention to the form, which is important as showing a color-pattern otherwise unknown in *Laminella*. The bands are very superficial, as if painted on. The typical example, no. 31404 U. S. Nat. Mus., from the Dall coll., has three bands. One in coll. C. M. Cooke, no. 2201, lacks the broad median band. Both are figured.

Sykes notes that "in the very fine series collected by Perkins, both dextral and sinistral forms occur; black bands are either absent or present, and in the latter event vary from one to even four in number."

Species of Maui.

L. picta and *bulbosa* are the more primitive forms, having relationships with species of Lanai and Oahu as well as with

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the group of small yellow species of Maui and Molokai. The other species have very close affinity with the Molokai forms.

a. Marked with separate, *deeply sunken,* dark stripes; 11x7 mm. *L. aspera,* no. 11.

*a*¹. Markings not conspicuously sunken.

b. Ground-color brown, with some obscure darker markings. *L. kuhnsi,* no. 10.

*b*¹. Ground yellow or reddish, *glossy;* length 12-15 mm.: diam. about ½ length.

c. Copious anastomosing black lines. *L. alexandri,* no. 9.

*c*¹. Widely separated black stripes. *L. a. duoplicata,* no. 9*a*.

*b*². Ground-color nearly white, dull; diam. usually more than ½ length.

c. Whorls strongly convex, with copious tracery of black zigzag lines or dots; length 14 to 19 mm. *L. picta,* no. 7.

*c*¹. Whorls less convex, the last with pattern of ragged streaks; spire paler or white; length 21-25 mm. *L. bulbosa,* no. 8.

✓ 7. L. PICTA (Mighels). Pl. 53, figs. 1 to 9.

Shell sinistral, short, thick, conical; light yellow with black zigzag lines, more or less numerous; perforate. Whorls 6, convex; aperture campanulate; lip simple, acute. Length .7 inch, average diameter .4 inch. Hab. Oahu (*Mighels*).

W. Maui: Lahaina (Gulick); Moomuku, Kahana, Honokohau (Thaanum); Iao valley (Perkins). E. Maui: Makawao (Baldwin); Haleakala at 4,000 ft. (Perkins).

Achatinella picta MIGH., Proc. Bost. Soc., N. H., ii, Jan., 1845, p. 21.—PFR., P. Z. S., 1845, p. 90; Monographia Hel. Viv., ii, 234; iii, 466; iv, 548; vi, 178; Conchyl. Cabinet, p. 284, pl. 67, figs. 28, 29.—REEVE, Conch. Icon., vi, pl. 5, f. 36. —NEWCOMB, P. Z. S., 1854, p. 311; Ann. Lyc. N. H. of N. Y., vi, 311 (animal).—THWING, Occas. Pap. B. P. B. Mus., iii, no. 1, p. 132, pl. 3, f. 3.—*Amastra* (*Laminella*) *picta* Migh., SYKES, Fauna Hawaiiensis, p. 351, with var. *bulbosa* Gul., p.

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52.—*Newcombia picta* Migh., W. G. BINNEY, Ann. N. Y. Acad. Sci., iii, 1884, p. 98, pl. 16, f. M (jaw), pl. 6, f. B (teeth).

"Animal densely black; tentacles long, slate colored; mantle and foot brownish-black" (*Newcomb*).

The locality given by Mighels is certainly erroneous. His type is lost, but the description applies to shells from Lahaina. This place, or rather the valley back, may be taken as type locality. The shell is turrited, the lateral outlines straight or slightly concave. The first ¾ whorl is smooth, corneous and convex; the second whorl is flat, finely striate and irregularly, coarsely but not strongly costate, and usually has some blackish longitudinal streaks (pl. 56, figs. 6, 8). Succeeding whorls are strongly convex, white or very pale-yellow, copiously marked with a tracery of black or blackish-olive zigzag or angular lines which may extend over the base, or stop short at the periphery in front. The last whorl is especially convex. The aperture is either pink or white within. Columellar lamella strongly developed, emerging to the edge of the well-reflexed columellar lip. Contour variable.

Length 16, diam. 10 mm.; whorls 6¼.

Length 15.3, diam. 9.5 mm.; whorls 6¼.

Length 14.3, diam. 7.7 mm.; whorls 6⅓.

In some specimens, also from Lahaina, the dark lines are broken into dots (figs. 4, 9).

An embryonic shell (pl. 56, figs. 6, 8) removed from one of these shells is figured. The second whorl is strongly costate and copiously marked; the columellar lamella is extremely small and low; axis perforate. Length 3.8 mm.; 2½ whorls. The acceleration of the color-pattern is a marked feature.

Figures 1 to 6 are from one lot of Lahaina shells. Fig. 1 may be considered typical. Some received from Newcomb, without exact locality, are larger, length 19, diam. 10.3 mm., typical in color. In some shells, figs. 3 and 5, the dark markings are distinctly sunken.

A lot from Makawao, E. Maui, in the Cooke collection from

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Baldwin, do not seem specifically separable from Lahaina *picta,* though their markings are heavier, and the shape more oblong. The mouth is pink (pl. 53, figs. 7, 8). Possibly they represent a variety or subspecies.

Dr. Newcomb describes the animal as "densely black, surface checkered by fine lines of a light color; tentacles slate, much produced; mantle and bottom of foot brownish-black; when extended same length as the shell."

Other shells (four in a lot of 38 from Lahaina, Gulick coll.) have the spire somewhat more concave, and opaque white, but showing a few small dark dots; the last whorl is subangular in front, and becomes more or less streaked and speckled with blackish or dark green on the last half. The aperture is flesh-colored within the base. Length 17.8, diam. 10 mm.; whorls 6⅓. These white-spired shells are entirely like some of the young of Kula *bulbosa* received from Gulick. The possibility of accidental mixture must be considered.

8. L. BULBOSA (Gulick). Pl. 53, figs. 13, 14, 15.

"Shell sinistral, imperforate or sometimes slightly perforate, subpyriform, rather solid, unpolished, striate, yellowish-white, covered with irregular streaks of black epidermis, which blend in broad patches towards the base; apex acute; spire concavely conic; suture simple, well impressed; whorls 7, convex; the last large; columellar fold central, brown, lamelliform, nearly transverse; aperture oblique, sinuately lunate, pale pink within, shading into brown near the columella; peristome thin, acute; with external margin unreflected, arcuate; columellar margin dilated, adnate, or sometimes slightly detached; parietal margin wanting. Length 21.6, diam. 13.2 mm.; average weight 7 grains" (*Gulick*).

Honuaula, E. Maui (E. Bailey); Kula, on trees and vines (J. M. Alexander).

Achatinella bulbosa GULICK, Ann. Lyc. Nat. Hist. of N. Y., vi, 1858, p. 253.—*Laminella bulbosa* GUL., Evolution, Racial and Habitudinal, 1905, p. 38, pl. 1, f. 10 (Kula).

"I have a dextral specimen, which is the only one I have seen belonging to any species of this group" (*Gulick*).

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The shell is larger than *picta,* with more confused and streaked pattern; last whorl often malleated. The spire may be white with rare green specks, or it may be rather well covered with green or olive-black lines. The specimens figured are from Kula, Gulick coll. This place may be selected as type locality.

Length 24.3, diam. 12.4 mm.; 7¼ whorls.

Length 21.3, diam. 11.5 mm.; 7 whorls.

Length 21.5, diam. 12 mm.; 6⅔ whorls.

An embryonic shell examined is entirely like that described above, except that it is a little smaller, with the columellar fold barely indicated by a narrowing of the columella.

9. L. ALEXANDRI (Newcomb). Pl. 52, figs. 1, 2, 9.

" Shell perforate, left-handed, elongately subcylindrical, shining, reddish-brown, with painting of elongate, inosculating black veins. Whorls 6, convex, regularly but slowly increasing; apex a little obtuse; suture moderately impressed, not emarginate; aperture small, subovate; lip acute; columella white, short, almost straight, truncate, terminating by a twisted plait passing within. Length .6, diam. .25 inch; aperture length .2, width .1 inch " (*Newc.*).

West Maui, at an elevation of 7,500 feet (Rev. M. Alexander); Puu Kukui (Thaanum).

Achatinella alexandri NEWC., Proc. California Acad. Sci., iii, Jan., 1865, p. 182; Amer. Journ. of Conch., ii, 1866, p. 216, pl. 13, f. 14.—THWING, Occ. Pap. B. P. B. Mus., iii, p. 132, pl. 3, f. 4.—*L[aminella] alexandria* Newc., HARTMAN, Proc. A. N. S., Phila., 1888, p. 42.

" This species is more cylindrical than any of its congeners, resembling most *A. remyi* Newc., which is longer, not umbilicated, more pointed at the apex, with a twisted, not truncate columella. From *venusta* and *citrina* Mighels it varies both in form and color. With some varieties of *picta* it claims analogy only in the general plan of painting. Its striking characteristics are its blunt apex, slightly rounded whorls, small aperture, short and white columella, umbilicus, and general plan of coloring " (*Newcomb*).

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Newcomb's original figure is copied, pl. 52, fig. 9. The shells we have seen (pl. 52, figs. 1, 2) differ from the description by having a pale greenish-yellow ground, otherwise they are typical. In embryonic shells the first whorl is flesh-colored and convex; second whorl flattened, becoming yellowish, first half unicolored, then distant brown spots appear below the suture. On the third whorl there are oblique, protractive, distant deep-brown stripes. The embryo consists of 2½ very smooth whorls.

With the beginning of the neanic stage the chocolate or black stripes are close, more or less forked above, or anastomosing into a network. On the last whorl they do not run over the base, at least on the front of the whorl. The neanic and last whorls are delicately striatulate, and so smooth that the shell is slippery to handle. The columellar margin suddenly dilates above, arching over the rather widely-open perforation. Columellar lamella well developed, very obliquely entering. Above it the columella is calloused and there is often a weak fold.

Length 13, diam. 6.2 mm.; 6 whorls.

Length 12.8, diam. 6.9 mm.

The embryonic shell described above was washed out of one of the adults figured. A set of three young shells received from Mr. Baldwin (without adults) are rather different. The first whorl becomes much darker in adults than in the embryos, as usual in *Laminella*.

9a. *L. alexandri duoplicata* Baldwin. Pl. 52, figs. 3, 4, 5.

Shell shaped as in *alexandri*, last whorl straw-yellow, the spire whitish, apex dull purple or blackish, last 3 to 4 whorls decorated with widely-spaced, protractive, black stripes, which neither branch or anastomose, and often become reduced in number and size on the last whorl. Columellar lamella rather blunt, and nearly always there is a second much smaller fold above it, often rather indistinct and sometimes wanting. Perforation variable in size, often nearly closed.

Length 13, diam. 6.5 mm.; 6 whorls.

Length 13, diam. 6.8 mm.

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Length 12, diam. 6 mm.

West Maui: Waiehu valley (Baldwin); Lahaina (Gulick).

Laminella duoplicata BALDWIN, Nautilus XXII, November, 1908, p. 68.

Differs from *alexandri* chiefly by the color-pattern, but the small accessory columellar fold seems to be developed more or less in most examples (5 out of 6 seen by H. P.), while in *alexandri* it is exceptional. Described and figured from cotypes, no. 104692, A. N. S. P. A specimen of this variety was found among *L. picta* from Lahaina, in the Gulick lot.

10. L. KUHNSI (Cooke). Pl. 52, figs. 11, 12; pl. 49, fig. 15.

" The shell is minutely perforate, sinistral, elongately conical, nearly solid, minutely and irregularly striate with lines of growth (the striæ slightly stronger just below the sutures), the first four whorls glossy, the rest somewhat glossy, *cinnamon brown* (apex darker), with a few indistinct irregular zigzag transverse brown lines on the penultimate and last whorls. Spire elongately conic, apex obtuse. Suture minutely crenulate, slightly oblique, well impressed. Whorls 6, the embryonic smooth, convex, the rest increasing slowly and regularly, convex, the last somewhat rotundate, tapering towards the base. Aperture rather large, broadly subovate, oblique, whitish within. Columella nearly straight; columellar fold median, oblique, not strongly developed, thick, blunt. Outer margin of lip convex, erect, thin; columellar margin thin, adnate above, below free, reflexed over the umbilicus. Umbilicus minute, circular. Length 13.4, diam. 6.5, length of ap. (diagonal) 5.5 mm." (*Cooke*).

West Maui: Kahakuloa (Kuhns, Baldwin). Type no. 15142, cotypes 16662, Bishop Museum,

Amastra (*Laminella*) *kuhnsi* COOKE, Occasional Papers B. P. Bishop Museum, iii, no. 2, p. 21 (217), (July 24, 1908).

" Specimens of a *Laminella* from West Maui under the name of *Laminella erecta* Pease were kindly sent the Bishop Museum by Mr. D. Thaanum. The shells were, I think, identified by Mr. D. D. Baldwin. Lately the specimens were compared with Pease's description and were found to differ con-

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siderably from the description. As there is no description with which it agrees I venture to describe it as a new species. I have followed Mr. Sykes in placing *Laminella* as a subgenus of *Amastra*.

" This species differs from *A. erecta* Pse., as all the specimens are sinistral and are minutely perforate. The brown epidermis covers the whole of the shell and is not fugacious as in all the other species of *Laminella*. The darker zigzag markings are in the epidermis and are, also, not fugacious. There is a straw-colored variety of which I have seen a single specimen " (*Cooke*).

A cotype from no. 16662 Bishop Museum is drawn in figs. 11, 12. It measures 11.8x6.8 mm., having 5½ whorls. There are some sparse dark markings on the last whorl of this individual. The type figure is also copied, pl. 49, fig. 15.

11. L. ASPERA Baldwin. Pl. 53, figs. 10, 11, 12.

The shell is perforate, conic, rather short; fleshy-white, yellow, or almost orange, the apex bluish or purplish black, last 2½ to 3½ whorls decorated with *irregular longitudinal black stripes which are deeply sunken;* the surface therefore being *strongly corrugated or plicate.* Rarely the stripes are absent, and the surface sunken in few places. 2⅓ embryonic whorls are smooth, the apex rather blunt and rounded, as in *L. alexandri.* Neanic and last whorls are strongly convex, marked with fine growth-lines. Aperture is short, wide, but slightly oblique. Columellar fold small, not ascending steeply. Above it the columella is calloused and bears a fold, sometimes irregular or small, sometimes almost as large as the columellar lamella.

Length 11, diam. 7 mm.; 5½ whorls.

Length 10, diam. 7 mm.

Length 10.2, diam. 6.2 mm.

West Maui: Wailuku valley (Baldwin).

Laminella aspera BALD., Nautilus, XXII, November, 1908, p. 68.

Very distinct by its sunken stripes. It is much shorter than the Molokaian *L. venusta,* a species having this character

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somewhat less developed. The figures are from cotypes, no. 104693, A. N. S. P.

Species of Molokai.

The data on distribution of Molokaian species is fragmentary, and little profitable systematic work can be done until the field is well explored. Borcherding has done valuable work by recording definite localities and giving good figures; but by dragging in the species *luteola* and *remyi*, surely not Molokaian, and by identifying *depicta* as *venusta*, he gives an impression of scrambled Laminellas. We heartily join in his belief that the species are excessively variable and rich in transition-forms.

Key to Species.

a. Pale yellow with sunken black stripes, often broken into spots; whorls strongly convex, especially the last; length about 14 mm. *L. venusta*, no. 13.

a[1]. Last whorl salmon tinted, aperture and columella pink; immaculate or dotted; length 14 mm. *L. v. muscaria*, no. 13*b*.

a[2]. Uniform yellow, dextral. *L. v. orientalis*, no. 13*c*.

a[3]. Narrowly pyramidal, glossy, whorls less convex; with black anastomosing stripes, sometimes broken. *L. depicta*, no. 12.

a[4]. Rather large, length 17 to 19 mm.; whorls convex.

b. Primrose yellow, uniform, early whorls dotted, or covwith a stippling or network. *L. citrina* and vars. no. 14.

12. L. ALEXANDRI DEPICTA Baldwin. Pl. 52, figs. 6-8, 10, 13-16.

The shell is sinistral, narrowly perforate or closed, narrowly pyramidal with obtuse summit and straight lateral outlines; thin but strong. The glossy surface is marked with very fine growth-lines and near the summit there are usually some shallow pits or cicatrices below the suture. Embryonic whorls nearly smooth, dark purple or pale; subsequent whorls but slightly convex, yellow or pale brownish-yellow or dull orange, typically marked with black or blackish-brown veins which

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anastomose more or less freely, and very frequently converge downwards forming wedge-shaped figures at the periphery of the last whorl (or rarely, dark markings are absent). The aperture is white within, the basal lip and columella white in yellow shells, reddish in the orange form. Columellar fold moderate. There is almost always a low callous fold above it on the columella.

Length 17, diam. 7.2, aperture 6.2 mm.; 7 whorls.

Length 15, diam. 7, aperture 6 mm.; 6¾ whorls.

Length 15, diam. 6.5, aperture 5.8 mm.

Molokai: Kamalo (Baldwin); Pelekunu valley and Haupu (Borcherding).

Laminella depicta BALDWIN, Proc. A. N. S., Phila., 1895, p. 228, pl. 11, figs. 33, 34, 35.—BORCHERDING, Zoologica, p. 89, f. 21.—*L. venusta* Mighels, BORCHERDING, t. c., p. 87, pl. 8, f. 22 (Haupu).—*L. alexandri* Newc., BORCHERDING, p. 88, pl. 8, f. 22.

Typical forms of *L. depicta* are more slender than *L. alexandri*, the spire being longer; yet this does not hold with all the Molokaian shells, some lots (pl. 52, figs. 6-8) being as wide as *alexandri*. The chief difference between the shells of *L. depicta* and *alexandri* is in the locality. Nobody could separate a mixed lot. While locality is a character to be given due weight, yet I am inclined to believe that this is a case of two now isolated colonies of an old species, which have not diverged enough to call for specific separation. Yet it may be that a thorough examination of the soft anatomy would show changes not recorded in the shell. Baldwin writes, "Animal extended in motion shorter than the shell. Mantle very light brown. Foot above and below almost white. Tentacles short, light brown. This species is allied to *A. alexandri* Newc., from the island of Maui, and to *A. remyi* Newc., from the island of Lanai, but differs from both in the color and habits of the animal."

Figures 13, 14, 15 are from shells of the type lot, no. 65711, A. N. S. P. In one of them there are no dark lines or markings of any sort. Figs. 14, 15 are from the types of Baldwin's figs. 34, 35. Figs. 6, 7, 8 are Kamalo shells received from

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Mr. Thaanum, showing decadence of color-pattern on the last whorl, such as occurs in other Molokaian Laminellas. Fig. 10 is an unusual color-form from the Cooke collection, in which the lines remain for the greater part single and separate.

Inconspicuous pits on the early whorls of most specimens show a relationship to *L. venusta,* in which the whorls, especially the last, are more convex than *depicta;* moreover, *venusta* is much less glossy.

Mr. Sykes notes that the fine series collected by Mr. Perkins above Pelekunu ranges "from pale-yellow to rich orange tinged with crimson. It is sometimes dextral, but sinistral forms predominate."

13. L. VENUSTA (Mighels). Pl. 51, figs. 1-10, 12.

" Shell sinistral, conical, body-whorl large and tumid; reddish yellow, beautifully ornamented with black zigzag lines, more or less numerous and regular; perforate; whorls 6; convex; aperture subovate, lip simple, acute. Length three-fifths, diam. four-fifteenths inch [15x6.3 mm.]. Hab. Oahu " (Mighels).

Molokai: Mapulehu (Baldwin).

Achatinella venusta MIGHELS, Proc. Boston Soc. N. H., ii, 1845, p. 21.—PFR., Monogr., ii, 234; iii, 466; vi, 179.—REEVE, Conch. Icon., vi, pl. 5, f. 32 (1850).—NEWCOMB, Ann. Lyc. N. Y., vi, p. 311, living animal.—THWING, Occas. Pap. B. P. B. Mus., iii, p. 128, pl. 2, f. 25.—BALDWIN, Catalogue, p. 8 (Mapulehu).—? *Laminella depicta, eine schlankere Forma von Haupu* BORCHERDING, Zoologica, p. 90, pl. 8, f. 20, on the same page called *L. remyi.—Newcombia venusta* Mighels, W. G. BINNEY Ann. N. Y. Acad. Sci., iii, 1884, p. 98, pl. 6, f. A (teeth).—(?) *Laminella venusta* Migh., GULICK, Evolution, Racial and Habitudinal, 1905, p. 38, pl. 1, f. 9 (Lahaina).

Mighels's description of *venusta* is inconclusive. The Portland Society of Natural History possesses three specimens which had been given by Mighels to J. H. Thomson, and by him turned over to the Society. Since the original type has

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been destroyed by fire, we propose to regard one of these shells (no. 218 Portland Soc. coll.) as the type. It is very conspicuously marked with scar-like, sunken areas at the stripes, and the summit is purplish. The traditional identification of *venusta*, as preserved in old collections such as that of the Academy, of Cuming (figured by Reeve), and of Newcomb, is therefore sustained. Two other shells of the same lot have the last whorl immaculate (pl. 51, fig. 12).

L. venusta differs from *L. alexandri* and *depicta* by the more swollen last whorl and the sunken black markings, which are generally coarser than in *depicta*, and do not form the characteristic *depicta* patterns.

The typical, copiously striped form (pl. 51, figs. 1-4) seems to be what Borcherding has figured as " a more slender form [of *depicta*] from Haupu," a place on the northern coast. Baldwin, however, gives Mapulehu, one of the southern valleys, as the locality of *venusta*. I suspect that Gulick's record of *venusta* from Lahaina, W. Maui, was based on a small *L. picta*.

The dimensions given by Mighels agree with some slender specimens before me. The color, " reddish yellow " appears on the last whorl of some shells, and the phrase " body-whorl large and tumid " is especially characteristic, and could not be applied to *A. depicta*. The assigned locality, like many in Mighels's paper, is certainly incorrect, for no such shell occurs on Oahu.

The shell is always sinistral (so far as we know), perforate or narrowly umbilicate, ground-color light yellow, sometimes orange towards the base. The outlines of the spire are more or less concave, the summit obtuse, reddish, violet or white, Initial half-whorl smooth and convex; following whorl flattened, more or less striate and weakly, longitudinally sulcate, the sulci distinct or weak, sometimes beginning on the first, sometimes not before the middle of the second whorl, the first 1½ whorls then being smooth. Some widely spaced oblique stripes begin on the second whorl, and about the middle of the third they become more or less irregular. Subsequent whorls have many angular or serrate black stripes *sunken*

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below the light intervals, the surface being more or less, and very irregularly, corrugated. Typically the stripes continue upon the last whorl. The aperture is white (rarely pink), rather oblique. Columella straight, abruptly dilated and reflexed above, bearing a small lamella. There are often one or two accessory callous folds above the lamella.

Length 15, diam. 7.3, aperture 6 mm.; 6½ whorls.

Length 13.5, diam. 6.2 mm.

Length 13.5, diam. 7 mm.

The animal of *L. venusta* is " slender, body flesh-color with black puncta down the sides; tentacles very black. When extended, two-thirds as long as the shell " (*Newcomb*).

13a. Color-var. *semivestita* H. & P., n. var. Pl. 51, figs. 6-10, 12.

Shell striped on the spire, the last whorl uniform yellow in the typical form; but in some specimens the dark stripes are represented only by a few dots, which may be numerous or very rare; others have stripes on the last whorl, but less numerous than in *venusta*. Columella uniplicate in the type lot, but biplicate in some others. Length 13, diam. 7 mm.

Doubtless connected with the typical form, but perhaps worthy of notice as a stage in the decadence of color-pattern.

13b. Var. *muscaria* n. v. Pl. 51, figs. 13-16.

There is also a smaller form, salmon tinted with the apical whorls paler or purple, the aperture and columella deep pink; marked at and above the periphery with spiral lines of black dots or short dashes, the base usually immaculate. The most fully marked individuals have the stippling arranged irregularly in subvertical series also, showing its origin in original subvertical stripes, and these are a little sunken, like the stripes of *L. venusta*. In one shell (fig. 14) there is a band of black blotches on the base. The least marked shells are merely minutely fly-specked, the dots either scattered or forming a subsutural series, in which case they are sunken. Above the small columellar lamella there is a more oblique callous fold, generally small and indistinct.

Length 13.8, diam. 7.5, aperture 6 mm.; 5¾ whorls.

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Length 14.2, diam. 7, aperture 6 mm.; 6¼ whorls.

Molokai: Cotypes no. 104716, A. N. S. P., and 1818 Univ. of Wisconsin.

Eight specimens of this race were in a collection presented by Mr. Jos. Dutton to the University of Wisconsin. By its size and the sunken streaks of the most fully marked shells it evidently belongs to *venusta*, but the pattern is practically identical with *semivenulata*, which so far as seen is invariably larger and yellow.

13c. Var. *orientalis* n. v. Pl. 51, fig. 11.

This name is proposed for the dextral form from Puukaeha (on the central ridge near the east end of Molokai), figured by Borcherding as *Laminella luteola* Fér. (Zoologica, p. 86, pl. 8, fig. 19). The figure indicates a rather deep yellow shell of the size of *A. venusta*. Whether the race at that place is dextral, or only the specimen figured, is not stated. Borcherding's figure is copied. The real *luteola* Fér. is probably a Hawaiian *Amastra*. See p. 321.

14. L. CITRINA ' Mighels ' Pfeiffer. Pl. 50, figs. 1-5, 8.

" Shell sinistral, oblong-conic, rather solid, very finely striatulate, glossy, buff. Spire long, slender, the apex somewhat obtuse. Whorls 6, the upper ones flat, the rest rather convex, last whorl subcarinate, the carina disappearing in front. Columellar fold doubled, the lower one stronger, twisted, lamelliform. Aperture semioval; peristome simple, acute, the columellar margin reflexed. Length 17.5, diam. 7 mm.; aperture 7x3⅔ mm. Sandwich Is., Mus. Cuming " (*Pfr.*).

Animal of a uniform light yellow color, superior tentacles and tentacular sheath light slate (*Newcomb*).

Molokai: Kalae to Waikola (Baldwin); Makanalua and Kahanui (Borcherding).

Achatinella citrina Mighels *in sched.* Cuming, PFR., Monographia Heliceorum Viventium, ii, 1848, p. 234.—REEVE, Conch. Icon., vi, pl. 5, f. 33 (1850).—NEWCOMB, Ann. Lyc. N. H. of N. Y., vi, p. 312, living animal.—BALDWIN, Catalogue, p. 7.—*Laminella citrina* Mighels, BOCHERDING, Zoolog-

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ica, p. 84, pl. 8, f. 17, and dextral form, f. 18.—GULICK, Evolution, Racial and Habitudinal, 1905, p. 38, pl. 1, f. 7.

A. citrina inhabits a narrow area perhaps 6 or 7 miles long, on the ridge of the island south of the northern peninsula. It is therefore rather widely separated from the area of the closely related *A. helvina,* so far as present information goes.

L. citrina is distinct from *L. venusta* variety *semivestita* by the larger size, when other characters fail. Pease (P. Z. S., 1869, p. 652) unites it to *venusta* as a plain variety. Typically it is spotless and very pale yellow throughout (primrose yellow of Ridgway's Nomenclature of Colors), the columella white. The type, and some specimens collected by Newcomb and Gulick, was weakly angular in front (not "subcarinate" as Pfeiffer says), by retention of a feature of immaturity; but most adult shells seen have the last whorl well rounded. The contour varies a good deal, as usual.

Two of these typical subangular shells are figured and measured below. Five out of the lot of six received from Newcomb are more or less distinctly biplicate, the others having the upper fold bifid. A few shells in this and another lot received from Newcomb have small olive dots or flecks scattered on the first two neanic whorls.

Pl. 50, fig. 2. Length 17.5, diam. 8.1 mm.; 6½ whorls.

Pl. 50, fig. 1. Length 16, diam. 8 mm.

Three specimens from the Mighels collection, procured through Thomson by the collection of the Portland Society of Natural History, are of the immaculate form commonly accepted as *citrina.*

In a large series received from Gulick, about one-third have the neanic whorls variously dotted, the dots sometimes scattered along the suture which is margined below (pl. 50, figs. 4, 5, 8). The rest are plain throughout. Columella biplicate. The only dextral specimen of *citrina* in the collection before me is dotted along the suture (pl. 50, fig. 4), and occurred in a lot of *citrina* otherwise sinistral and plain. Borcherding has figured a plain dextral specimen from Kahanui, in the central part of the island.

Several lots in the Cooke collection, received from Baldwin

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consists of spotless shells in which the yellow color becomes much deeper on the last whorl, in some becoming deep chrome behind the lip. Columella uniplicate (pl. 50, fig. 3). Other shells are pale yellow, with more or less olive punctation or streaking on the early whorls; columella white, usually one-folded but very strongly biplicate in one shell. In some shells the last whorl is unusually swollen, others being normal in shape. Length 17.8, diam. 9.8 mm. Length 19, diam. 9 mm.

14*a*. L. CITRINA HELVINA Baldwin. Pl. 50, figs. 12-15.

" Shell sinistral, imperforate or subperforate, sometimes narrowly and deeply perforated, rather thin, elongately conical, apex rather acute; surface scarcely shining, covered with very fine incremental striæ; nuclear whorls smooth. Color uniform light or dingy yellow, with a few black markings on the upper whorls. Whorls 6½, lightly margined above, convex; suture deeply impressed. Aperture a little oblique, oval, white, with the tint of the outside; peristome simple, thin, margins connected by a thin, orange-yellow callus; columella biplicate, the terminal plication a thin, oblique lamellar plait, the inner one less prominent, tortuous, of an orange-yellow color. Length 18, diam. 10 mm.

" Animal extended in motion as long as the shell. Mantle and foot above and below very light brown. Tentacles dark slate, with a sprinkling of slate on the sides of the foot. Posterior portion of foot very tapering and thickly studded with minute red spots. A remarkably prolific species; 4 or 5 embryonic shells in successive stages of growth often observed in the oviducts. A jaw is present and the dentition is the same as that of the Amastra species. The tooth formula of this species is $32.1.32 \times 108 = 7{,}020$. The central tooth is a little wider than usual " (*Baldwin*).

Molokai: Ohia valley, near Kaluaaha (Baldwin).

Laminella helvina BALD., Proc. A. N. S., Phila., 1895, p. 227, pl. 11, f. 30.—BORCHERDING, Zoologica, p. 91, pl. 8, f. 25.

This shell is shaped like *L. venusta*, the last whorl being more swollen than in typical *citrina*, though not more than in some forms of that species. Typically it differs from

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citrina by the very strongly biplicate, orange or reddish columella; but these are variable features. Baldwin writes: "The typical forms are found in the small valley of Ohia on Molokai. Departing from this locality on either side, modified forms without the biplicate columella are somewhat common."

In the cotypical lot, 65712 A. N. S. P., there are two color-patterns. In three specimens the neanic whorls have olive-black dots and a few dotted streaks (pl. 50, figs. 12, 14, 15), the apex salmon colored in two of them. Baldwin's figured type (fig. 14) was one of these. In four shells, streaks predominate, there being few dots or none, apex gray or yellow (pl. 50, fig. 13). In all, the markings begin on the second whorl, and are most numerous on the third and fourth, in some shells continuing on the fifth. There are weak traces of pits or depressions on the second whorl, but the dark streaks are not sunken as in *L. venusta*. The columella in all is more or less deeply orange tinted, this color often extending weakly upon the parietal callus. The columellar folds are subequal in 4, the lower one much larger in 6 of the shells examined. In one shell there is a small intermediate fold.

Length 19, diam. 9.8, aperture 7.7 mm.; whorls 6¾.

Length 17.5, diam. 9.7 mm.

Length 17, diam. 8.8 mm.

Length 17, diam. 9.8 mm.; whorls 6½.

The figures represent cotypes, fig. 14 being that originally illustrated by Baldwin.

In an embryo of 3 whorls, length 4 mm., the first whorl is smooth, the second and third longitudinally costate. The columella shows no trace of a lamella, and the axis is almost closed (pl. 56, fig. 3).

14*b*. L. CITRINA SEMIVENULATA Borcherding. Pl. 50, figs. 6, 7, 9, 10, 11.

Shell sinistral, imperforate, sometimes distinctly perforate, rather solid, smooth (very finely striated longitudinally under the lens), somewhat shining, pale buff, figured with very small black spots, the upper whorls and the last one below the middle elegantly ornamented with black veined lines.

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Spire turrited, the apex subacute, suture well impressed, with a thread-like margin. Whorls 6½, the first flattened, the rest convex, last whorl inflated, nearly half the total length. Aperture slightly oblique, ovate, whitish; columellar fold biplicate, the lower fold stronger, twisted, lamelliform, upper fold less prominent; columella roseate or white; peristome simple, unexpanded, rather thin. Length 18, diam. 9 mm. (*Borcherding*).

Molokai: Manawai, on the southern slope.

Laminella semivenulata BORCHERDING, Zoologica, xix, Heft 48, p. 92, pl. 8, f. 24, and var. f. 23 (1906).

Borcherding's type figure is copied, pl. 50, fig. 6. Also his figure of a "transition-form to *L. citrina,*" from the same locality, pl. 50, fig. 7. Some figures are added of specimens in coll. C. M. Cooke (figs. 9, 10, 11).

On the third whorl there are often some oblique stripes, reminiscent of an earlier pattern, before the stippled stage sets in (pl. 56, fig. 7); rarely a modification of this pattern continues, as in pl. 50, fig. 9, but usually it gives place to a fine stippling, or scattered fly-specks, with a blotched band on the base, the ground-color being yellow. The striped stage is often omitted. Length 15 to 18 mm.

Similar coloration is seen in the neanic stage of some individuals of *helvina* and *citrina,* as noted above.

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APPENDIX A.

Additions and Corrections.

Leptachatina mauiensis (Pfeiffer).

Shell subrimate, oblong, rather solid, smoothish, pale corneous; spire convexly turrite, the apex obtuse; suture margined. Whorls 6, scarcely convex, the last about two-fifths the length, somewhat compressed basally. Columella vertical, somewhat twisted inward, truncate at the base of the subrhombic-oval aperture; peristome simple, obtuse, the columellar margin a little reflexed, adnate. Length 7, diam. 3 mm.; aperture 2½ mm. long, 1½ wide (*Pfr.*).

Maui (Newcomb).

Achatina mauiensis Pfr., P. Z. S., 1854, p. 126; Monographia, iv. 620.—*Cionella* (*Zua*) ? *mauiensis* Pfr.-Cless., Nomencl. Hel. Viv., p. 333, no. 8.

This species has been overlooked by writers on Hawaiian shells. It seems to be a slender *Leptachatina,* and Dr. C. M. Cooke, to whom I applied, thinks it close to *L. fulgida* (p. 12), perhaps the same species.

All published information is given above.

Leptachatina irregularis (Pfeiffer).

Shell imperforate, dextral, rather thin, longitudinally closely plicate; blackish, sometimes banded with whitish. Spire irregular, conic, obtuse; suture subcrenate; whorls 5½, rapidly increasing, convex, the penultimate swollen, the last about three-sevenths the total length, smoother below the middle, sometimes corneous. Aperture slightly oblique, oval-oblong; columellar fold above, little projecting; peristome simple, the right margin arching somewhat forward, colu-

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mellar margin dilated, adnate. Length 9, diam. 4⅓ mm., aperture 4⅓ mm. long, 2⅓ wide. Sandwich Is., Frick, in Cuming coll. (*Pfr.*).

Achatinella irregularis PFR., P. Z. S., Lond., 1855, p. 205 (Feb., 1856); Monogr. Hel. Viv., iv, 546.

This unfigured species has been considered an *Amastra* by authors who have noticed it. Mr. C. Montague Cooke agrees with me in referring it to *Leptachatina*. It is almost certainly identical with *L. fusca* Newc., p. 89, which has priority.

P. 21. LEPTACHATINA SAXATILIS (Gul.). Add the synonym *L. saxitilus* Hartman, Proc. A. N. S., Phila., 1888, p. 55.

P. 52. LEPTACHATINA CINGULA (Migh.). Add: Pl. 12, fig. 5.

P. 54. LEPTACHATINA VENTULUS (Fér.). In line 5 from top add the words "columella short" between "within" and "umbilical." Add the synonym *Achatinella manoaensis* Newc. Ms., PFR., Monographia, iv, 545; vi, 177; viii, 235; Nomencl. Hel. Viv., p. 311, no. 159. This name has been quoted as a synonym in several works, but no description has been published.

P. 73. LEPTACHATINA LEUCOCHILA. In 12th line from bottom replace "his" by "this."

P. 74. LEPTACHATINA STRIATULA (Gld.). Pl. 12, figs. 4, 7 (not 4, 5).

P. 75. Pl. 12, fig. 5 does not represent *Ach. clara* Pfr., as stated on p. 75. It is *Leptachatina cingula* Migh., p. 52.

P. 92. LEPTACHATINA PETILA Gul. Pl. 11, fig. 9 represents the type specimen; copied from Sykes.

P. 99, last line: type of *F. longa* is 10214 A. N. S. P.

P. 111. CARELIA RIGIDA is, according to Dr. Cooke, a fossil species from the eastern or northeastern side of Hanalei; *C. turricula* from the center and western side of the valley.

PTERODISCUS HELICIFORMIS (Ancey). Pl. 36, figs. 1, 2, 3.

See page 127. Three specimens, part of the original lot, from the collection of D. D. Baldwin, are now before me. They are less fragile than other Pterodisks. The embryonic shell, of fully 2 whorls, measures 2.3 mm. in diameter. The last third of a whorl has a peripheral cord, and is grooved

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slightly above it, as in the embryos of most species of this genus. The embryonic whorls are slightly convex, but they do not project mucro-like. The specimen figured measures, alt. 6.3, diam. 9 mm.

The reference to figures of *P. heliciformis* on p. 127 should read " Pl. 36, figs. 1, 2, 3."

P. 162. Upper third of page, for " *Series of A. variegata* " read *Series of A. reticulata.* A similar correction is to be made on the following page, and on the 14th line from bottom of p. 158. On p. 162, the paragraph beginning " This Oahuan group " should follow the diagnosis of *Metamastra.*

P. 226. After A. porphyrostoma read Pl. 37, figs. 8, 9, 13.

P. 227. Line 10, read Fig. 13 in place of Fig. 12.

Line 12 from bottom read 8, 9 in place of 8, 13.

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APPENDIX B.

Classified List of Amastræ, and Zoogeographic Deductions, from Hyatt's MSS.

The manuscripts on *Amastrinæ* submitted to the junior author contain no discussion of the zoogeographic data bearing on Hawaii, and the Molokai-Maui group is considered only in connection with *Laminella*. The discussion of Oahu, with references to Kauai, is printed in full below, following the classified list.

Note.—Substitutes have been inserted in square brackets for a few names in the original list which for one cause or another are untenable.

I. *Hyatt's classified list of genera and species of Amastrinæ.*

Carelia Ads.

[Species substantially as in pp. 103-117.]

Armiella Hyatt.

A. knudseni Bald.

Kauaia Sykes.

K. kauaiensis Newc.

[Cyclamastra P. & V.]

[C.] cyclostoma Bald.
[C.] sphærica Pse.
[C.] obesa Newc.
[C.] carinata Gul.

[Pterodiscus Pils.]

[P.] cookei Hyatt.
[P.] heliciformis Anc.

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AMASTRELLA Sykes.

Kauai.

A. similaris Pse.
A. brevis Pfr.
A. nucleola Gld.
A. anthonyi Nc.

Oahu.

A. antiqua Bald.
A. extincta Pfr.
A. vetusta Bald.
A. breviata Bald.
A. pellucida Bald.
A. transversalis Pfr.
A. cornea Newc.
A. crassilabrum Nc.
A. albolabris Nc.

Molokai.

A. petricola Nc.
A. subnana Hy.
A. [nubifera Hy. & Pils.]
A. subobscura Hy.
A. elegantula Hy.

Lanai.

A. extincta(?)
A. longa Sykes.
A. pulla Newc.

East Maui.

A. subcrassilabris Hyatt.
A. nana Bald.
A. subpulla Hyatt.
A. subsoror Hyatt.

West Maui.

A. soror Nc.
A. interjecta Hy.
A. [johnsoni Hy. & Pils.]

Hawaii.

A. melanosis Nc.
A. gyrans Hy.
A. flavescens Nc.
A. hawaiensis Hy.

METAMASTRA Hyatt.

([Textilis] subseries.)

A. [textilis] Fér.
A. media Hy.
A. rubicunda Bald.
A. tenuilabris Gul.
A. decorticata Gul.
A. inflata Pfr.
A. luctuosa Pfr.

(Reticulata subseries.)

A. orientalis Hy.
A. [errans] Hy.
A. badia Bald.
A. undata Bald.
A. reticulata Newc.
A. dispersa Hyatt.

AMASTRA Ads.

(Tristis subseries, Oahu.)

A. tristis Fér.
A. seminigra Hy.
A. rubens Gld.
A. corneiformis Hy.
A. grossa Pfr.
A. rubinia Hy.
A. elliptica Gul.
A. rubida Gul.
A. cylindrica Nc.
A. porphyrea Nc.

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(Violacea subseries.)

Molokai.

A. violacea Newc.
A. macerata Hyatt.
A. nubilosa Migh.

East Maui.

A. gigantea Newc.
A. conicospira Smith.

Lanai.

A. magna Newc.
A. nucula Smith.
A. aurostoma Bald.

(Pullata subseries.)

Molokai.

A. pullata Bald.
A. subnigra Hy.
A. uniplicata Hartm.
A. modesta Ad.
A. simularis Hartm.
A. advena Hyatt.
A. umbrosa Bald.

West Maui.

A. nigra Nc.
A. mastersi Nc.
A. mucronata Nc.
A. montana Bald.
A. affinis Nc.
A. rustica Gul.
A. pupoidea Nc.
A. bigener Hyatt.
A. cinderella Hyatt.
A. malleata Sm.
A. conifera Sm.
A. farcimen Hartm.

PARAMASTRA Hyatt.

(Turritella series.)

Oahu.

A. turritella Fér.
A. variegata Pfr.
A. tenuispira Bald.
A. frosti Anc.

East Maui.

A. hutchinsonii Pease.
A. [læva Bald.]

(Nigrolabris series.)

Oahu.

A. nigrolabris Sm.
A. rudis Fér.
A. spirizona Fér.
A. intermedia Nc.

Molokai.

A. villosa Sykes.

(Biplicata series. *Lanai.*)

A. obscura Nc.
A. moesta Nc.
A. [durandi Anc.]
A. biplicata Nc.

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LAMINELLA Pfr.

[Species substantially as in the text, but their affinities are somewhat differently estimated. See below.]

II. *Migrations of Amastra* (Hyatt's MS.).

The general trend of migrations in all of the islands is here assumed to be from Kauai to Hawaii.

METAMASTRA.—This group has been divided into two subseries, because in these *Am. textilis* or some form of its series is the primitive or radical form of the associated or branching forms. The evidence of this series as a whole is strongly in favor of the theoretic assumptions of this paper. The *reticulata* subseries does not afford much evidence, but it shows clearly derivation from *textilis*, and, in spite of gaps in the evidence, there are no facts positively contradicting any of my theoretic results. The *textilis* subseries, however, presents a fine series of gradations and these all harmonize perfectly with the theory of descent of primitive species from Kauaian Amastræ; the incoming of migrants at the southeastern extremity of Oahu, their successful colonization of the valleys of this region first, their subsequent migrations with the evolution of new forms as they traveled northwards, and lastly the final colonization of the western range of Oahu by migrants from the east range.

This series ranges from Nuuanu to Ahonui on the eastern range, but it is not represented in many of the valleys between these two. It is also found on the western range from Lehui to Waianae. The transitions from *textilis* seem to have occurred through the *Am. orientalis* of the eastern range. These facts accord with the position here taken that the fauna of the western range was derived from that of the eastern range, and was of later origin. The accompanying assumption that the fauna of the eastern range itself was derived from Kauai through *Am. textilis* its most primitive form, is also well supported. The final theoretic conclusion that the landing place of the Kauaian colonists was at the most southeasterly end of the island is sufficiently but not so strongly sustained as the above. There is a gap between *Am. orientalis*

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of the valley of Wahiawa and *Am. textilis* of Halawa, with some six valleys between them. There are species of this series, *Am. badia* and *undata,* found as far south as Nuuanu, but these are only known through highly specialized forms with very blunt apices. The evidence that there was a landing made at the southeastern end of the eastern range by the primitive ancestor of the series, viz., *textilis,* is strong enough, but the gap between this species and *orientalis* in their distribution, which is more or less filled by some specialized species may be due to insufficient exploration, but it does not give positive evidence of a northward continuous migration of *textilis* into *orientalis* and of the latter into the other species of the *reticulata* series that should be demanded for demonstration.

Reticulata Subseries.—Amastra textilis connects directly with *orientalis* of the eastern range, and this last is transitional to *reticulata* and *conspersa* of the western or Waianae range. These species have generally the reticulated and olivaceous pattern which rarely occurs in *Am. textilis.* The tendency to evolve extremely blunted spires is also peculiar to this series.

PARAMASTRA SERIES.—This series is remarkable for its evenly developed spire which can, with the exception of the earliest age, be expressed by a single angle in most of the species. While this is a wide departure from typical Amastran forms of Oahu and such forms as *A. rugulosa* of Kauai, it is very similar to the more turritelloidal and primitive Kauaian species *A. brevis.* The aspect of the columella also, which is often perforated and has a well developed fold and is straight with a similarily situated tooth-fold, and the similarity of the aperture and smooth apex, are all characteristics showing affinity for *A. brevis.* Thus it seems to be shown so far as collateral evidence goes, that the series has been derived from the species of Kauaian Amastræ directly, without the intervention of any intermediate form having less primitive characters. Nevertheless if one follows the species through their intermediate forms, the series is built up according to the table. In this it will be seen that there

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are only two species on the inner watershed of the east range, *A. turritella* and *A. nigrolabris,* connected in a line according to their geographic distribution, *turritella* occupying the more southern valleys and overlapping *nigrolabris,* that is found only in the more northern valleys. These are both radical of two subseries that were evolved in the western range. The *turritella* subseries is the most interesting and most highly modified, not only in *turritella* itself but in its apparent descendants. The shells are narrower and more elongated than in the other subseries, and in their evolution on the western range the banded pattern becomes probably of specific value in *A. cylindrica.* In other series, as stated above, this pattern appears occasionally on this range, but not at all perhaps on the eastern range, and always in a few shells appears to be distinct only as varieties of accepted species. There is a decided trend towards albinism in *turritella,* that, however, tends as in the *nigrolabris* subseries, to affect the exposed sides and leave the base dark, if any color is retained. Shoulder-bands are also formed as in *spirizona* and some shells of *nigrolabris.* When, however, the western range is reached the variations are different, and in *rudis* the base of the last volution fades out, often leaving sides or dorsum comparatively dark.

The forms of the *nigrolabris* subseries are larger and darker than the above. Their affines on the western range are also large shells, but, except for the decisive shoulder-band in *spirizona,* do not exhibit similar tendencies to become banded. There is, however, a decided tendency to the evolution of albinoid variations but these are apt to retain a dark base and have the dorsal sides lighter, just the reverse of the other subseries.

The wide gap between *turritella* of the southern valleys and the Kauaian *A. brevis* is not so satisfactory evidence as exists in other series of the probable derivation of this genetic series from migrants that come from that island to Oahu by way of the southeastern valleys of the Konahuanui [i. e., Koolau] range. The collateral evidence is, however, all in this direction. It appears to be certain that the most highly

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modified shells in the *turritella* subseries both in color pattern and form, viz., *A. cylindrica* and its affines, occur at Waianae on the western range, and that the second subseries must have arisen from a modified descendant of *turritella, A. nigrolabris,* that starts upon its career of evolution somewhere in or about the valley of Kalaikoa. This valley is the next in succession going north to Waipio, which last marks the northward extension of *A. turritella,* unless the Peck collection is correct in carrying this species to Helemano.

The reader will see at once that one cannot trace two subseries back into one radical species occurring in the southeastern valleys of the eastern range especially in a wave like this, where other series have been traced, with abundant evidence, in the opposite direction.

The overlapping of *turritella* to the north to this extent, if it were true, would, however, not invalidate the zoological evidence. The conjunction of both subseries in the valleys of the eastern range, and their continuation in the more modified forms of the Waianae range, can be accounted for only on the supposition that they arose in that range, and subsequently migrated to the western range. The distribution of the two species *turritella* and *nigrolabris* and their relations, in converging lines of affinity and distribution, point to *turritella* of the southernmost valleys as the probable ancestor of the entire group. There is one doubt in my mind, that is whether *A. variegata* and *turritella* are so closely connected as is here represented. I have thought that more materials might transfer this species and its affines to the same series with *rubens.* This removal, however, would resolve the group into one series and still leave the argument intact for this series, which would then be a single line of species from *turritella, nigrolabris, rudis, spirizona.*

III. *Relationships and migrations of Laminellæ, according to Hyatt.*

The species of this genus found on Oahu are much larger and stouter shells than those of Molokai (which are decidedly dwarfish), and somewhat larger also than those of Maui

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or Lanai. The patterns of color are primitive and Amastra-like in the most primitive species of the group, *L. gravida,* that occurs in the southern valleys of the eastern range, from Waialae to Makiki, and reappear in the western hills in Waianae, according to Cooke's collection. The aperture and columella become darker in this form, but the pattern remains similar. The primitive brown periostracum of *L. gravida* is wanting in some of its varieties, and in *L. straminea,* but modifications are retained, and no reticulated or zigzag markings are present. The evidence of transition from *gravida* to some species of *Amastra,* although less convincing than if intermediate varieties had been actually found, is nevertheless, considering the Amastra-like characteristics of *gravida,* sufficiently complete to indicate that *Laminella* originated from some form of *Amastra.* There is only one species of that genus, however, that approximates closely in appearance, and when this is compared it is seen to be obviously different. This is *A. grossa,* in which some varieties are very similar to *L. gravida.* The affinities of *gravida* are, however, decidedly more with the *turritella* series, to which this species belongs, than to any other. The form of the spire and general aspect being much alike.

There is a distinctly barred pattern in the young of *L. gravida,* but this subsequently gives place to a uniform pattern. The young of *L. sanguinea* are so similar to those of *L. venusta* of Molokai that the latter must perhaps be considered a dwarfed descendant of *sanguinea* of Oahu. The protoconchs in both of these species are of a dark color, and the shape of the spire is peculiar on account of the closely coiled and slender aspect of the younger or apical volutions, as well as the barred and zigzag patterns. The dwarfish species of Molokai are succeeded in West Maui by a shell, *L. picta,* that runs close to *venusta,* but is considerably larger; and this is succeeded in East Maui by *L. bulbosa,* a larger but closely allied species. The species of Lanai, *L. tetrao,* is more closely allied to *L. picta* of W. Maui than to any other.

The genus can in fact be divided into two sections, which are in accord zoologically and zoogeographically: The first

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section is found, one species in Oahu and one in Lanai. The most abundant species is *L. gravida.* This form connects the whole series as stated above, with *Amastra.* This inference, based upon the form, periostracum, and development, is also not inconsistent with the habitat of *L. gravida,* which occupies semi-arboreal positions on bushes, and also arboreal stations, but only on leaves of certain species of short trees especially the olona. *L. concinna* is found only on Lanai and is perhaps a dwarfish descendant of the *L. gravida.* It has a similar stout spiral, the apex has a suffused pinkish tone in most shells, and the colors are superficial.

L. gravida leads into a very distinct variety, *L. suffusa,* and in another direction to the albinic shell *L. straminea.* The turritelloidal character of the spire is most pronounced in certain varieties of *sanguinea,* reported also as occurring upon bushes and ferns. The nearest affine of this shell on Oahu is L. *gravida* passing into *suffusa,* which sometimes has a pink shell with a dark periostracum and dark apex. But the pattern and aspect of *L. sanguinea* is not that of a denizen of Oahu. Its zigzag pattern and narrow spire would be more suitable in Molokai or Maui than in this island. Under these circumstances it is not practicable to decide whether *sanguinea* arose on Oahu, or is descended from some form that migrated from Molokai or Maui. Information is also scanty with reference to the direction of migrations on Oahu, but so far as the evidence goes it would seem to have been in the usual direction, from the southern valleys to the north and then to the west.

L. sanguinea is certainly the most highly specialized form and thus occurs only in the more northern valleys of the Konahuanui range, while *gravida* stops short with Nuunau, leaving a gap from there to Ahonui of numerous valleys in which neither species has been observed. This gap may possibly account for the want of obvious connection between *sanguinea* and *gravida.* At any rate the distribution and relations of the more Amastra-like *gravida* shows that the migrations of the group were from the south to the north. Since *gravida* is alone represented and only by a rare and

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modified form in the Kaala range, it follows also that the directions of these migrations was finally turned towards the west. That the *gravida* may have been artificially transported to the western range must also be admitted, so long as the evidence remains as it is at present, because any natural transit across the valley of the Ewa district would be impossible from a point so far south. Luckily the arrangement of the second section, which comprises all shells found to the eastward of Oahu, does not present the difficulties just noticed in tracing the genealogy of *L. sanguinea.*

It is comparatively easy starting with *L. venusta* of Molokai to trace this by gradations into *L. depicta,* and this in turn into *helvina* and *citrina.* There is also a lateral offshoot from *venusta* in *L. alexandri.* In whichever direction one looks at related forms, whether to the west or the east of Molokai, it is obvious that this fauna, so far as *Laminella* is concerned, is retrogressive in size. That it is not retrogressive in the pattern of coloration is shown by the evident relationship of the highly colored and complex pattern of *sanguinea* on Oahu to the simpler *gravida.*

In passing from the dwarfs of Molokai to the larger shells of West Maui, strong evidence of direct connection between *venusta* of Molokai and *picta* of the last locality is shown in all the characters of all the species, including their development, and it is evident also that the latter is the progressive descendant form, if the migrations of the species took the same direction as those of other genera. The evidence with regard to this is not as complete as is desirable, but it is certainly easier to account for the generation of the different island faunas of *Laminella* by assuming an easterly set from island to island of the tide of migration, starting with Oahu, than to start with Lanai and end in Oahu. In West Maui *L. picta* leads into *L. bulbosa* of East Maui, and connects more nearly with *L. tetrao* of Lanai than the latter. This accords with the geographic approximation of W. Maui to Lanai, and the connection of the fauna in other genera.

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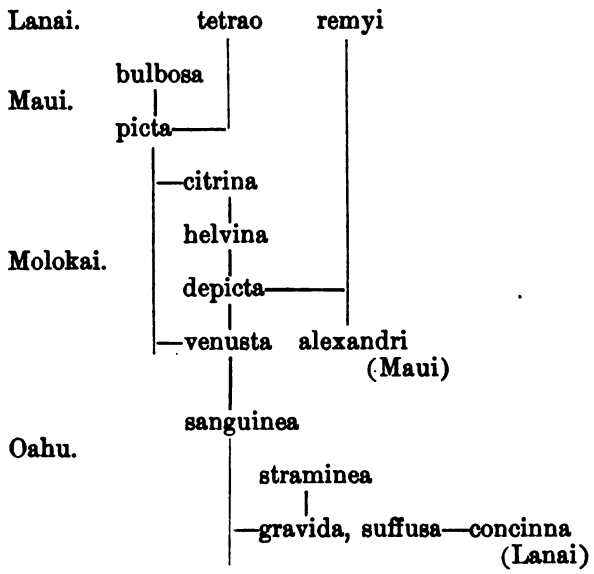

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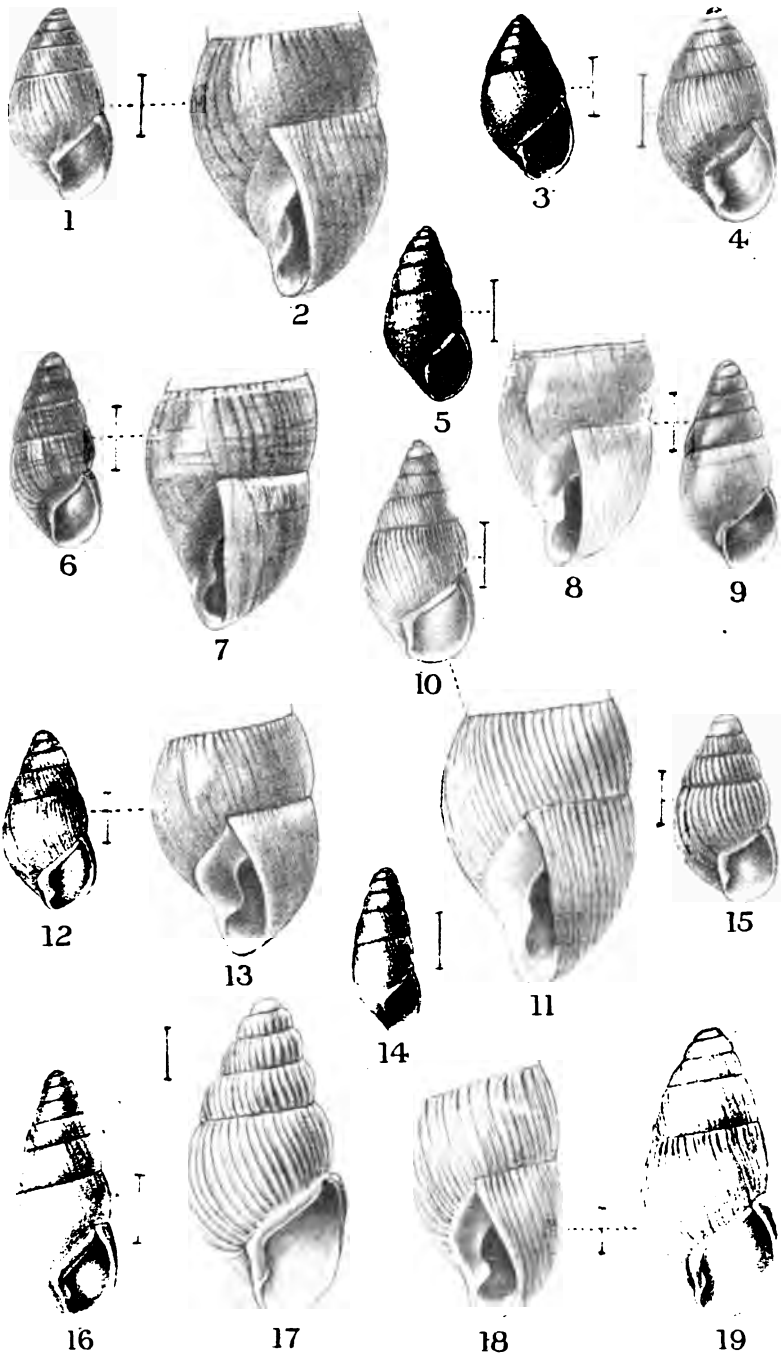

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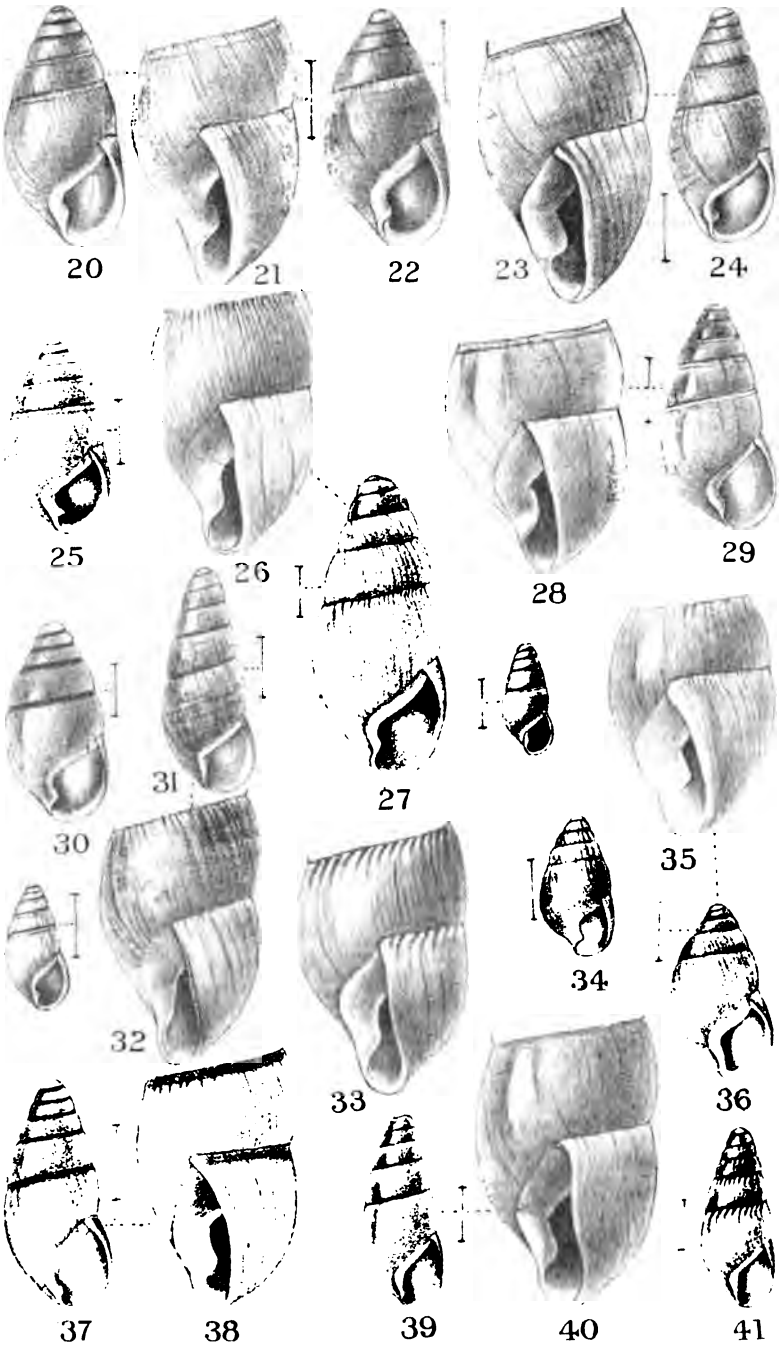

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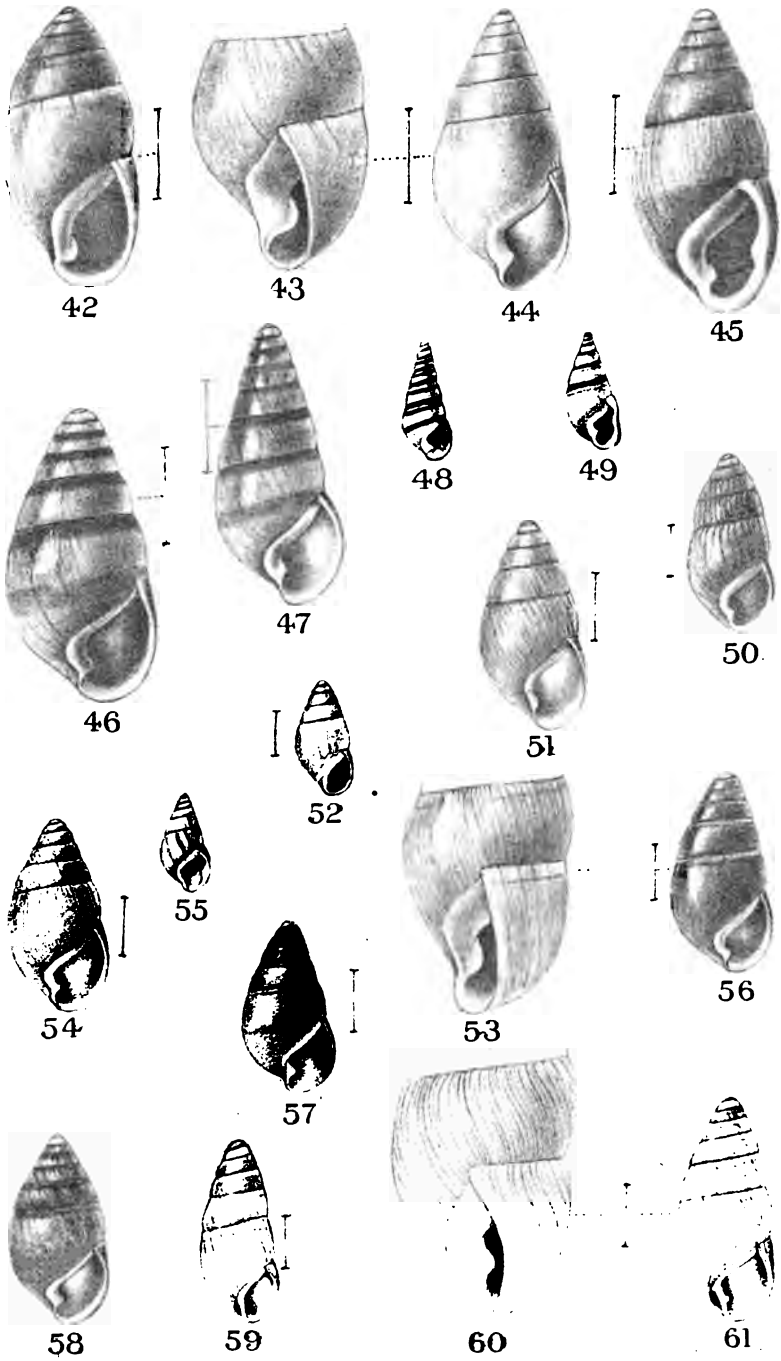

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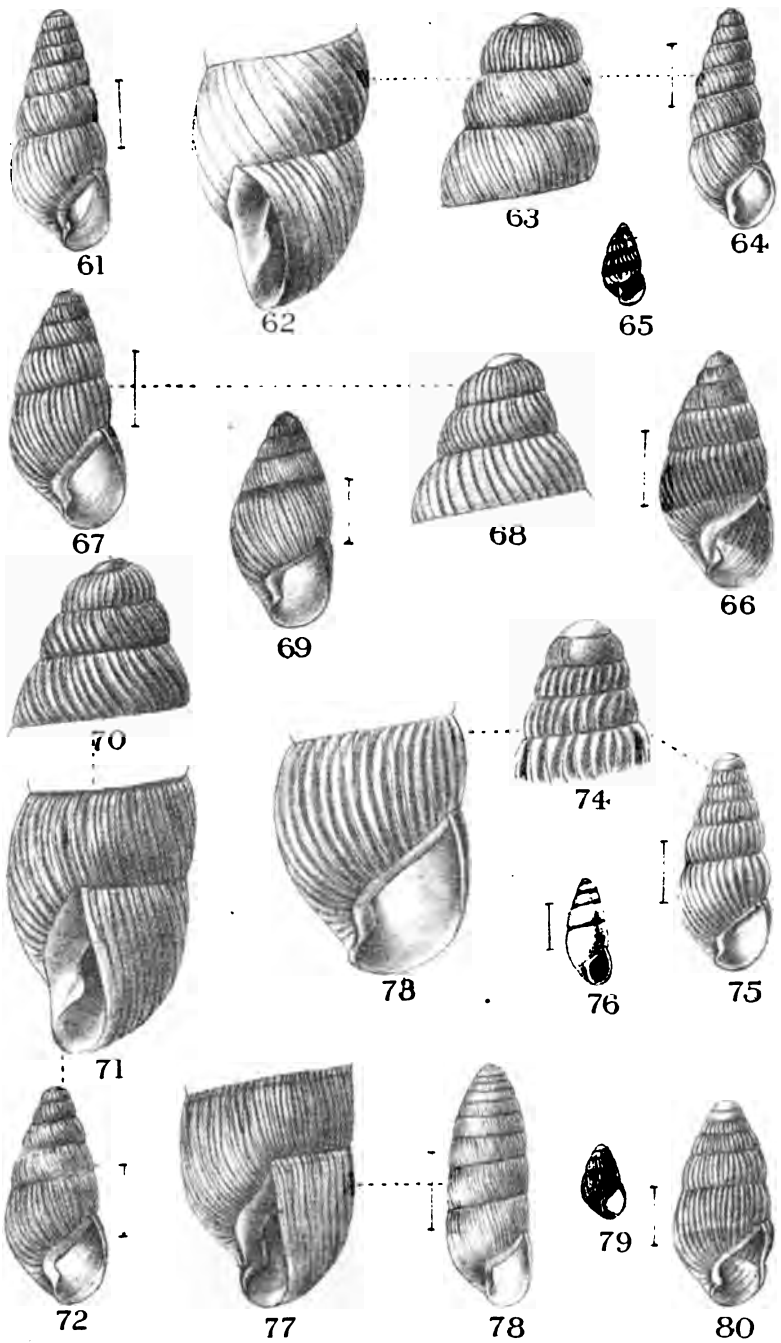

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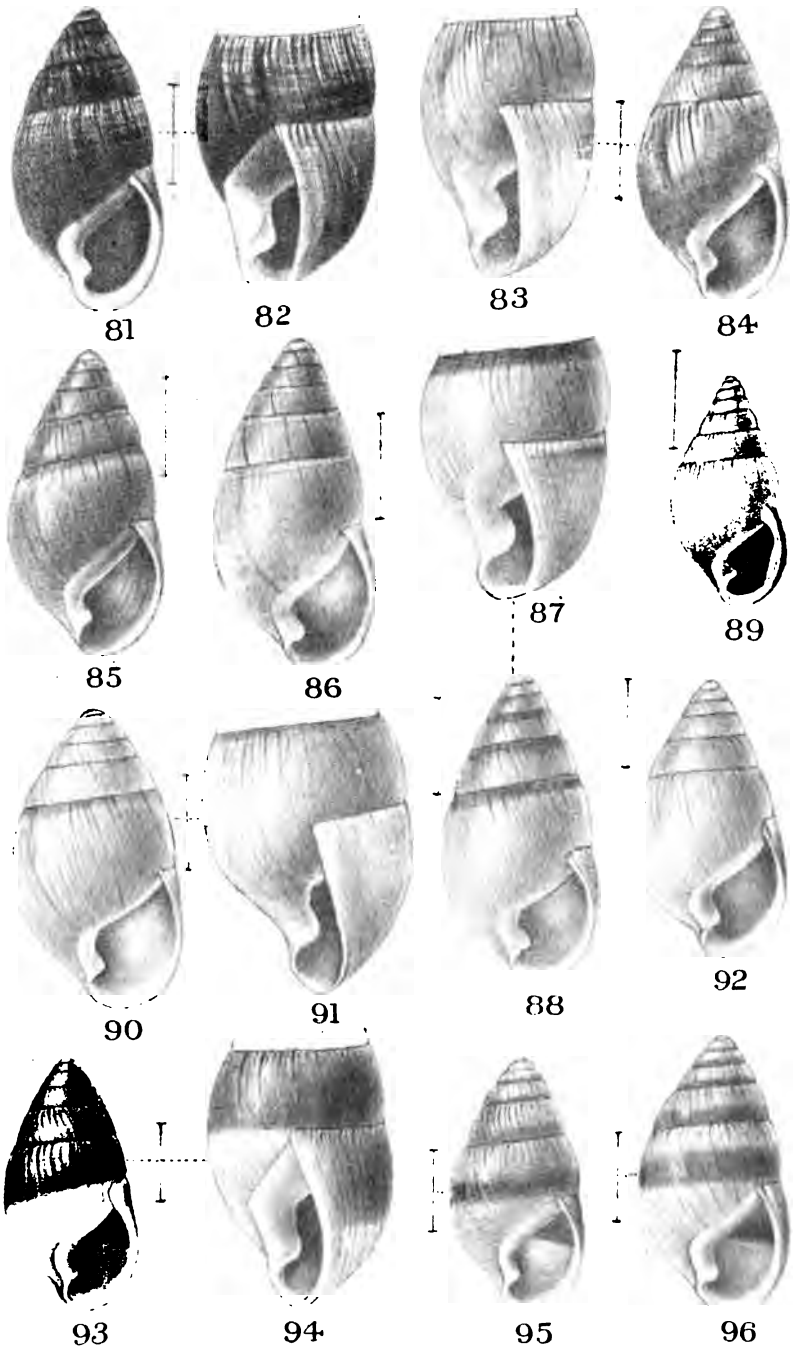

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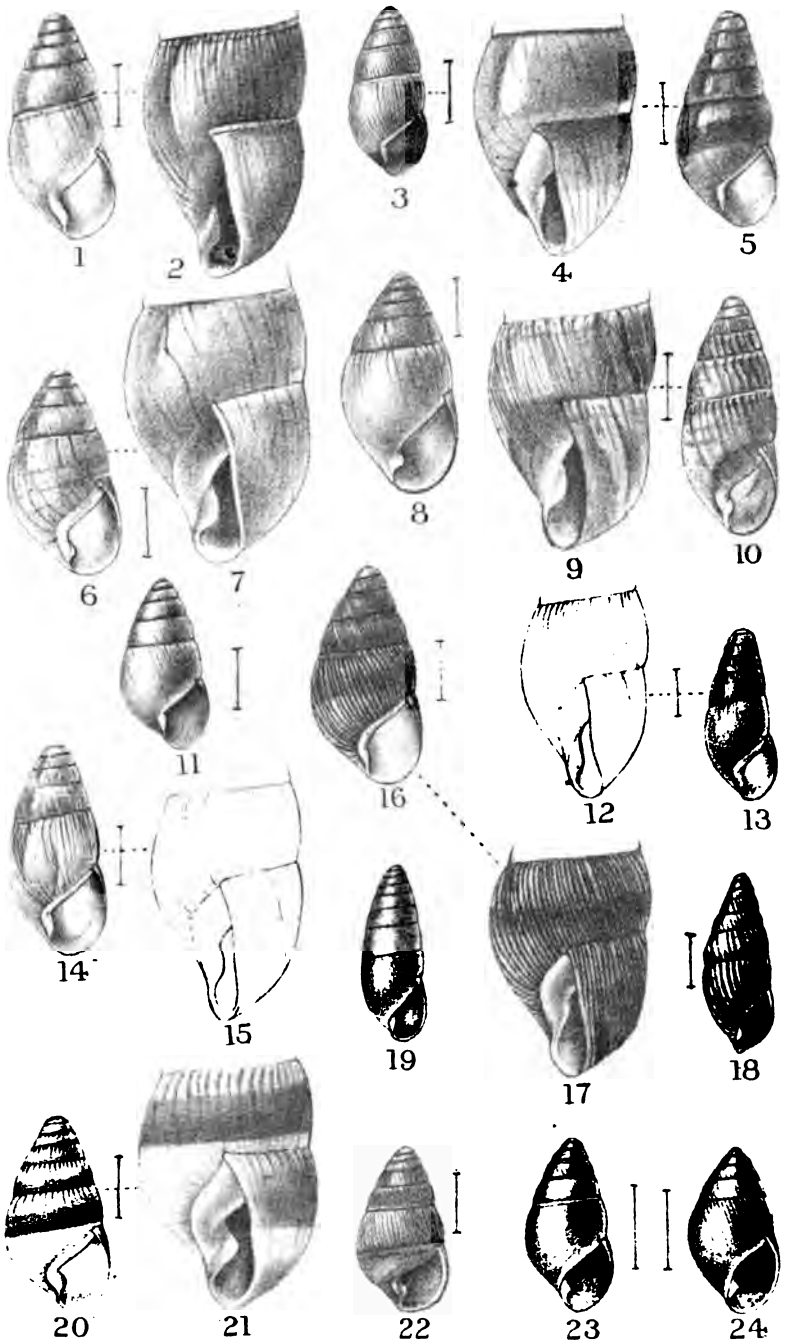

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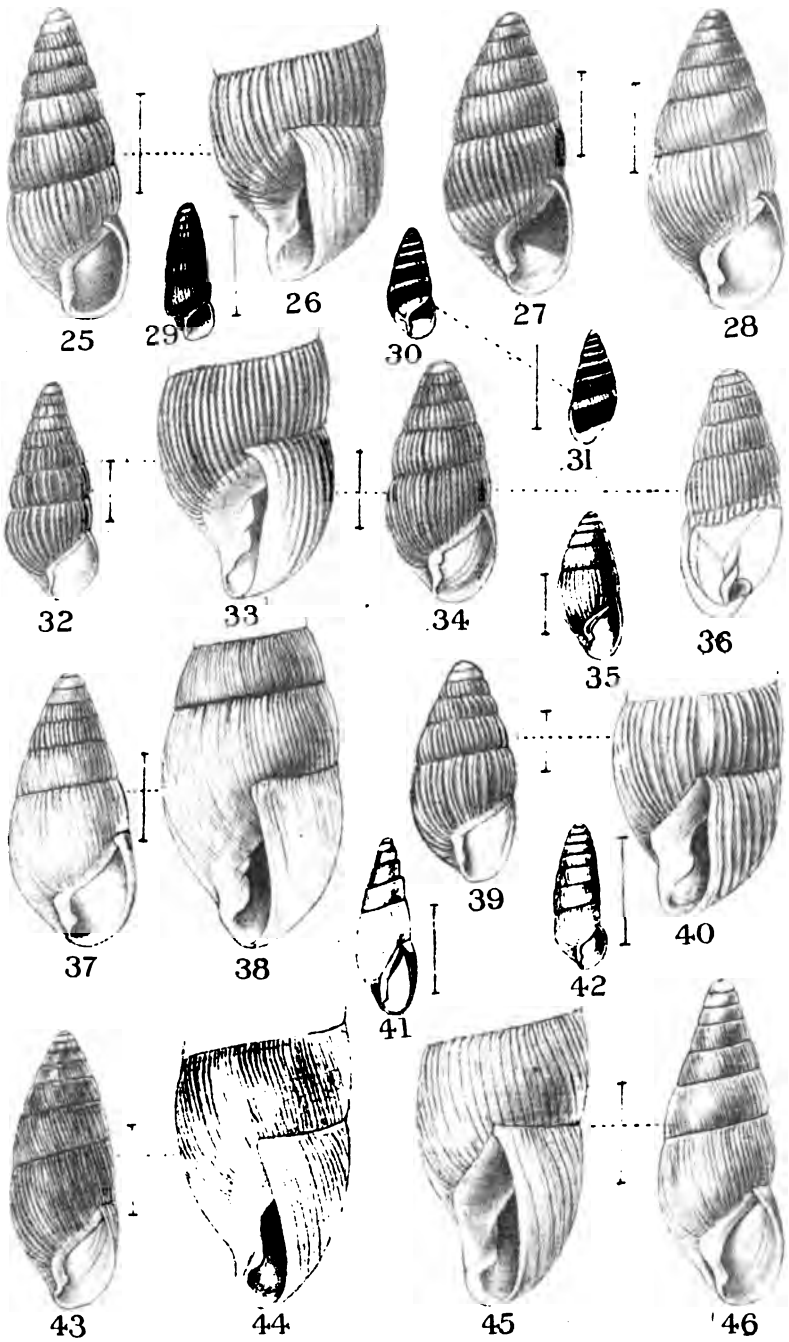

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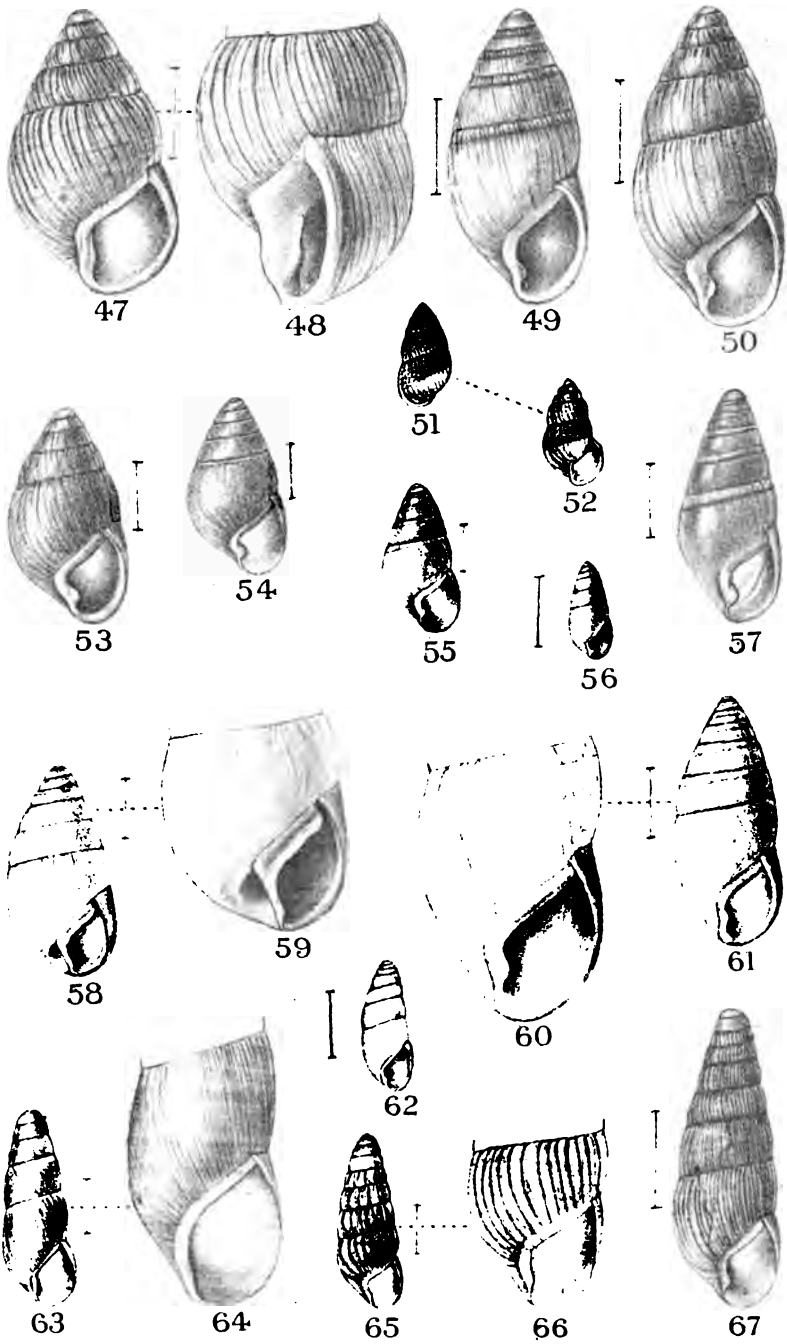

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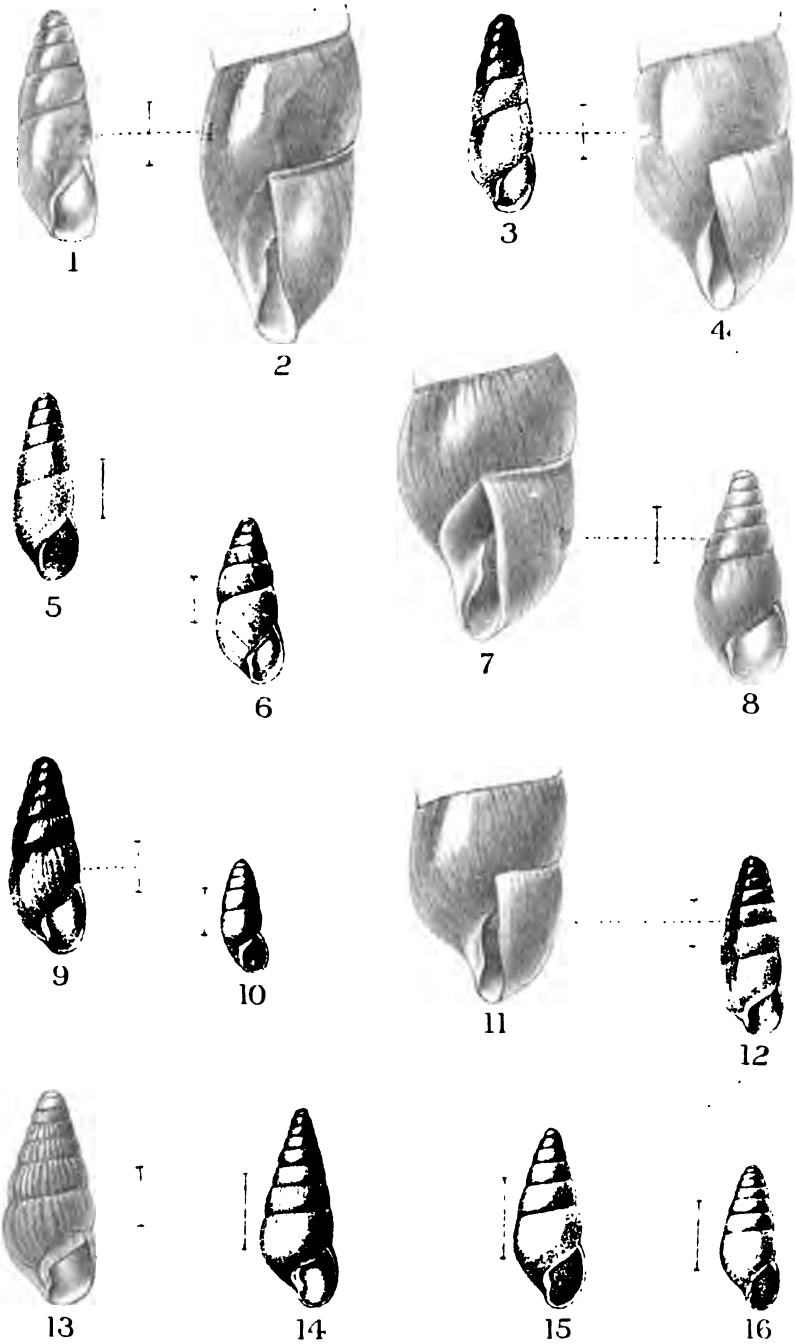

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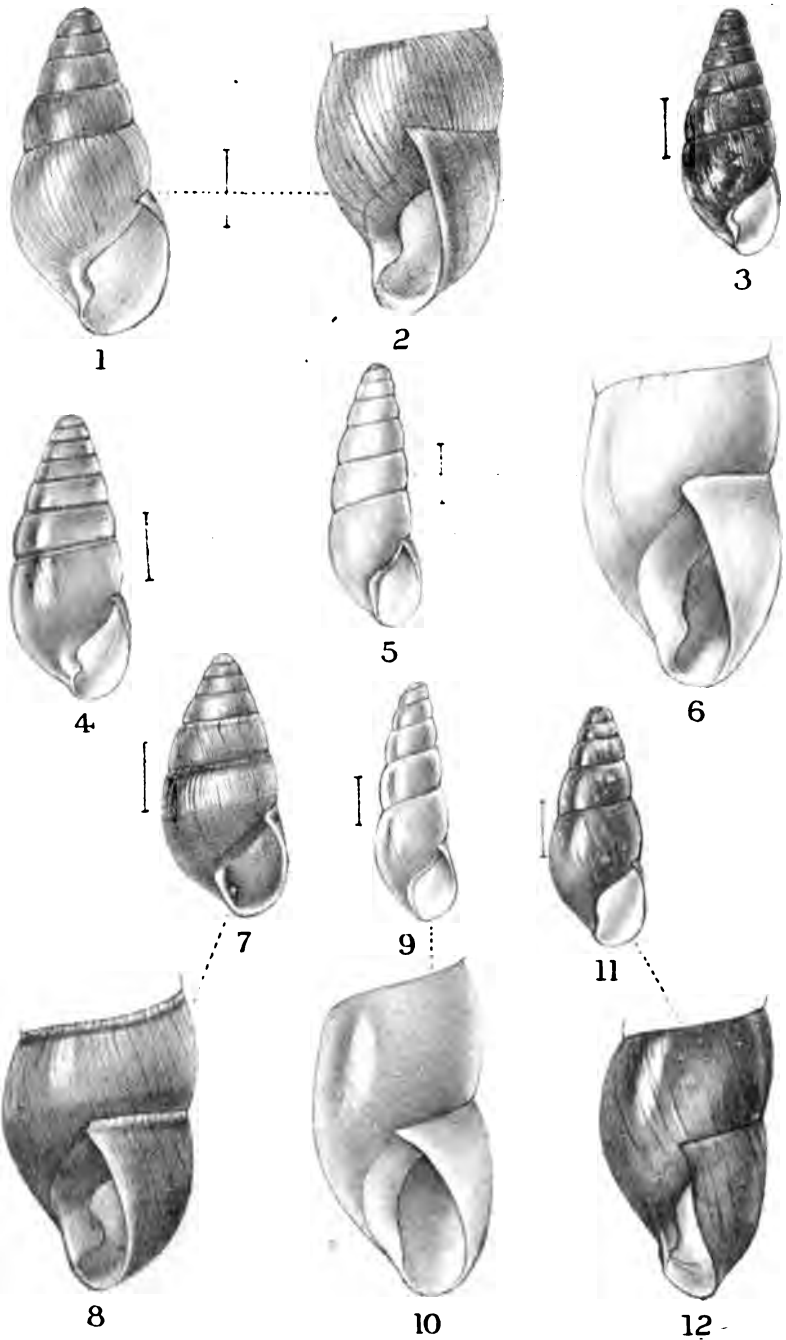

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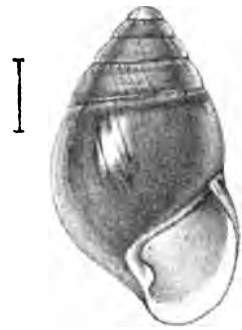

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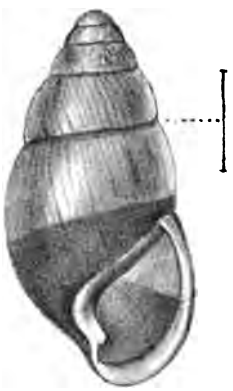

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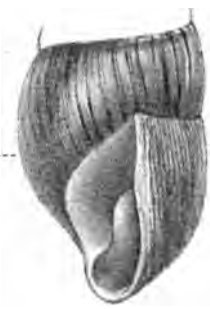

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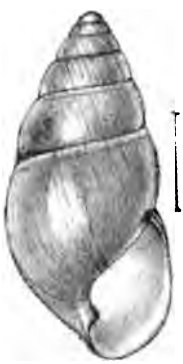

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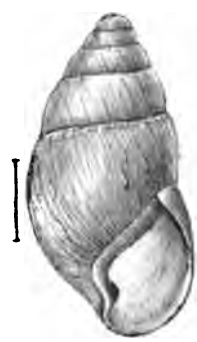

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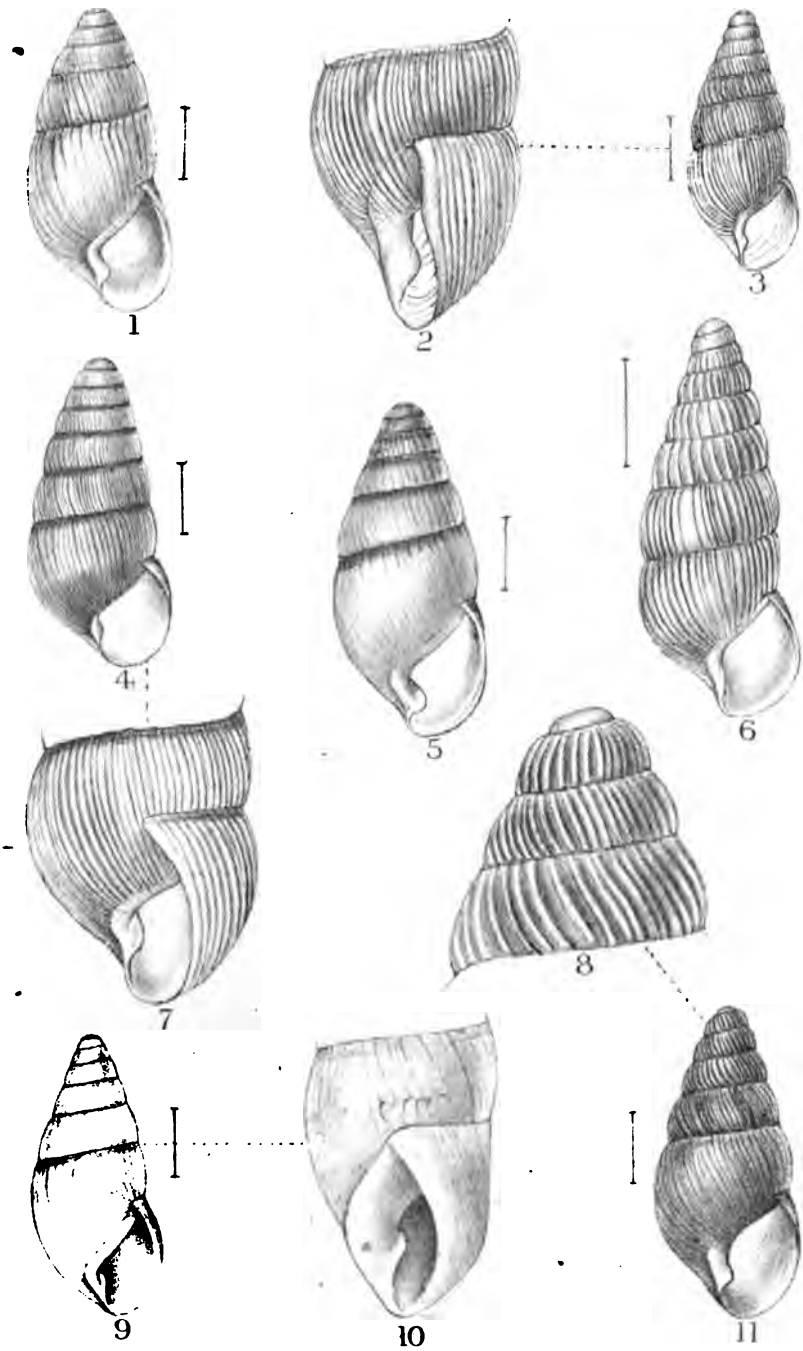

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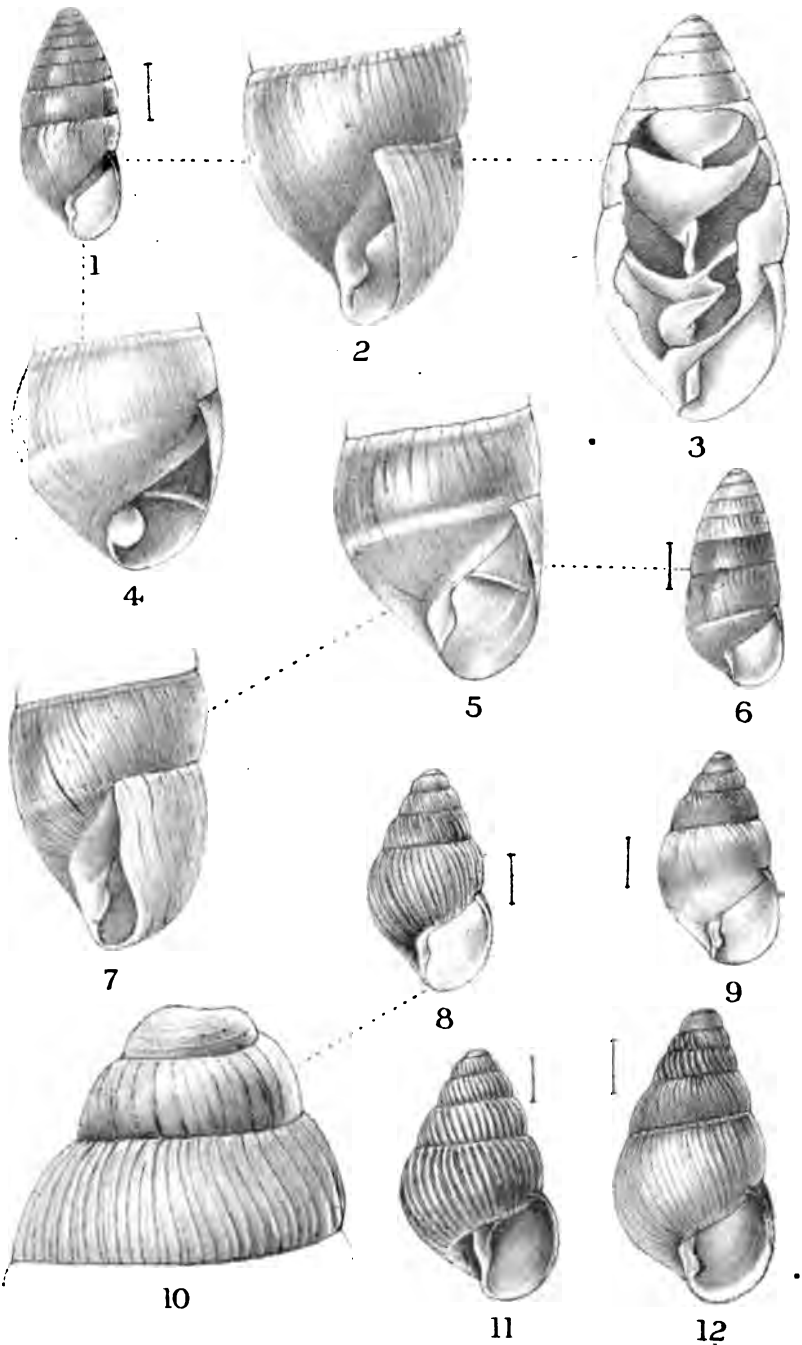

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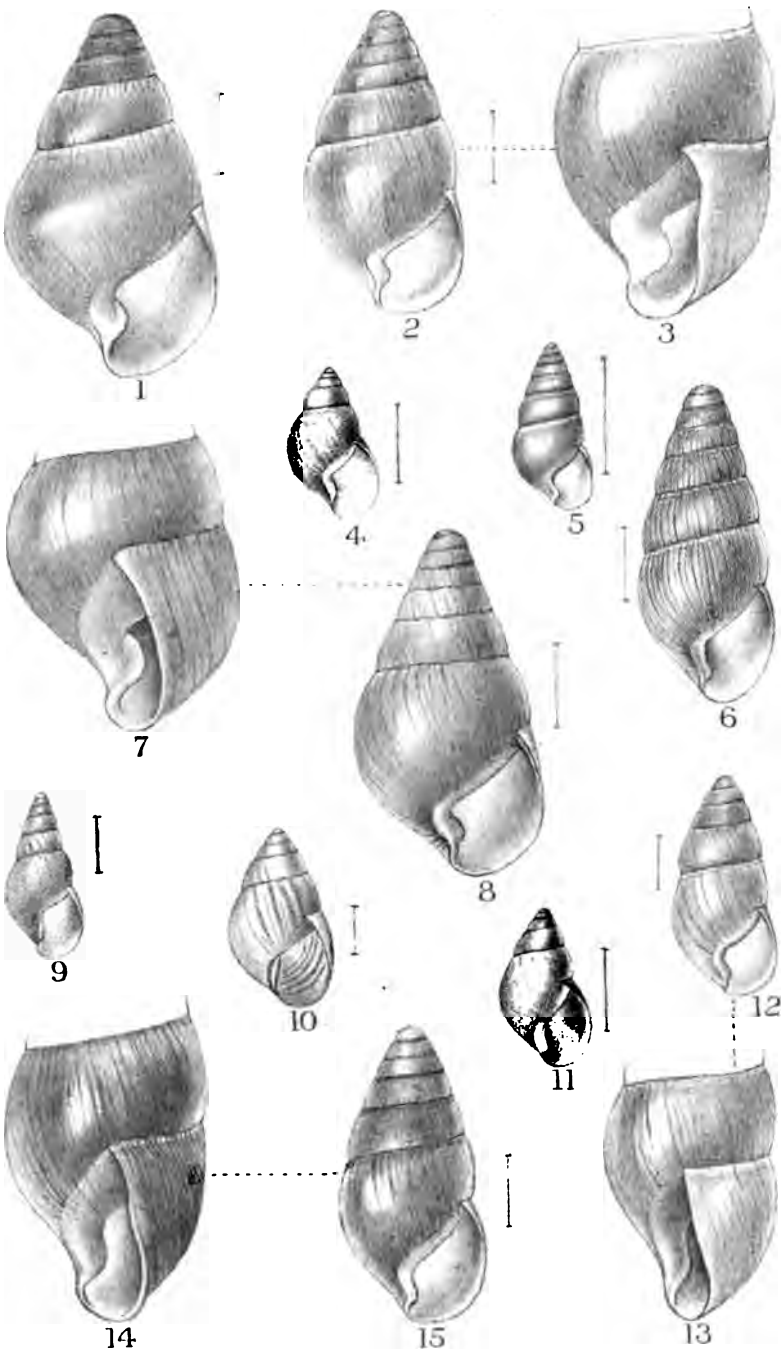

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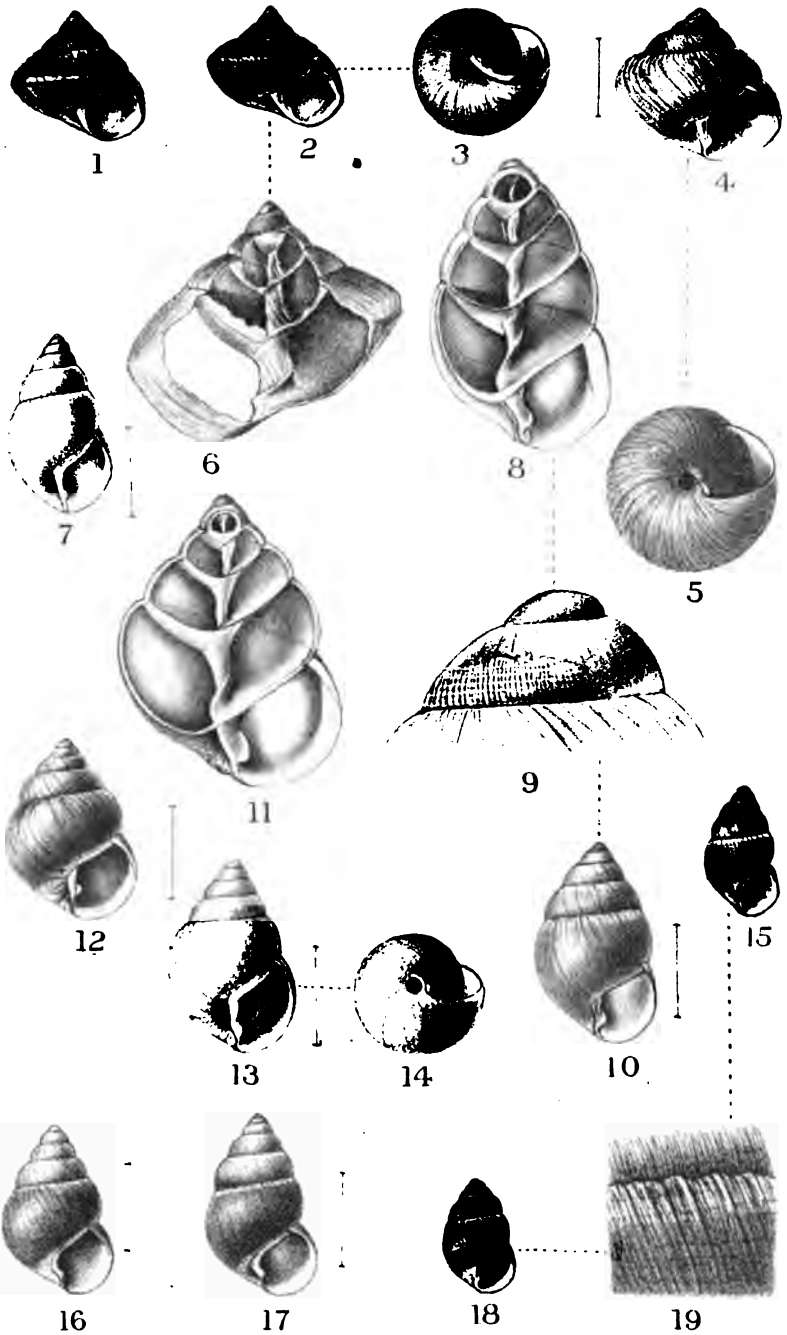

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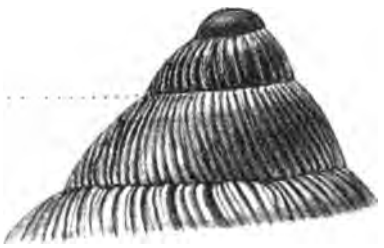

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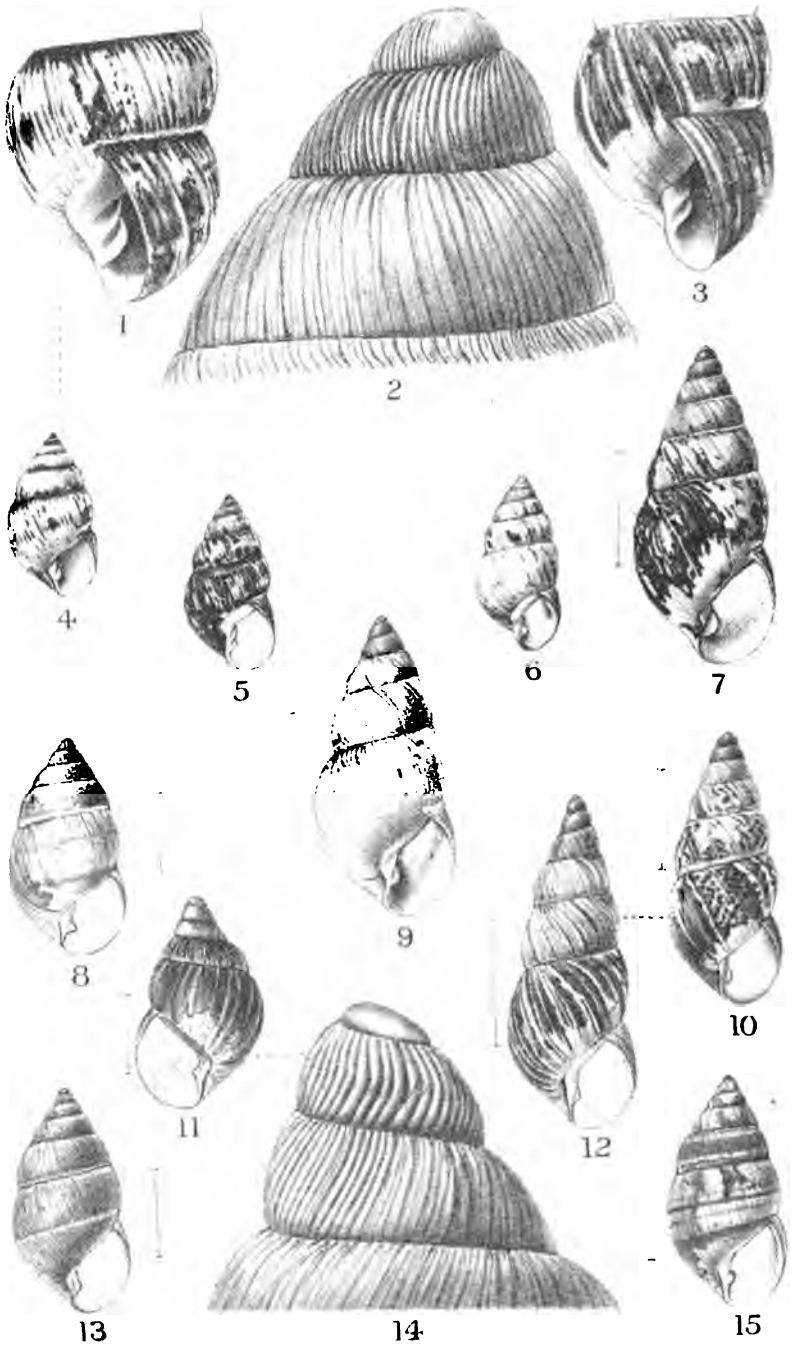

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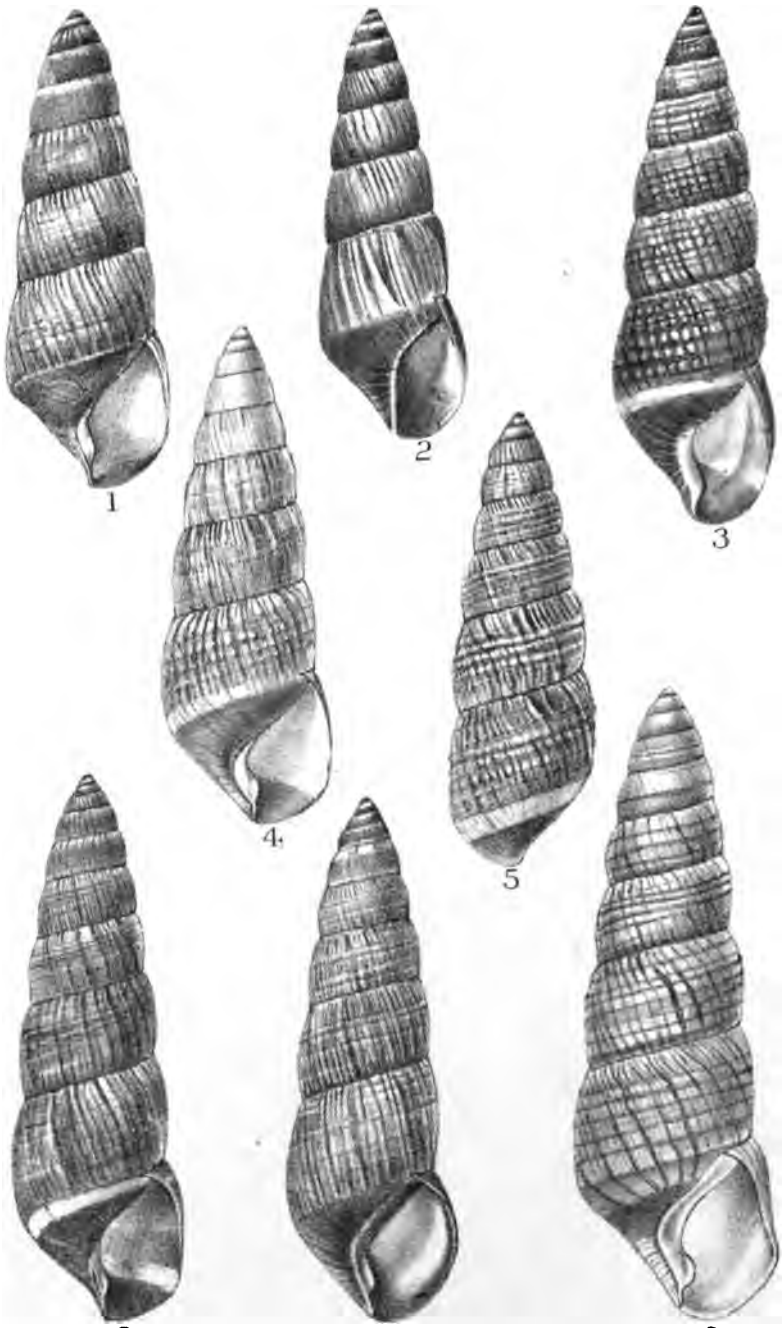

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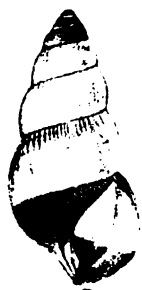
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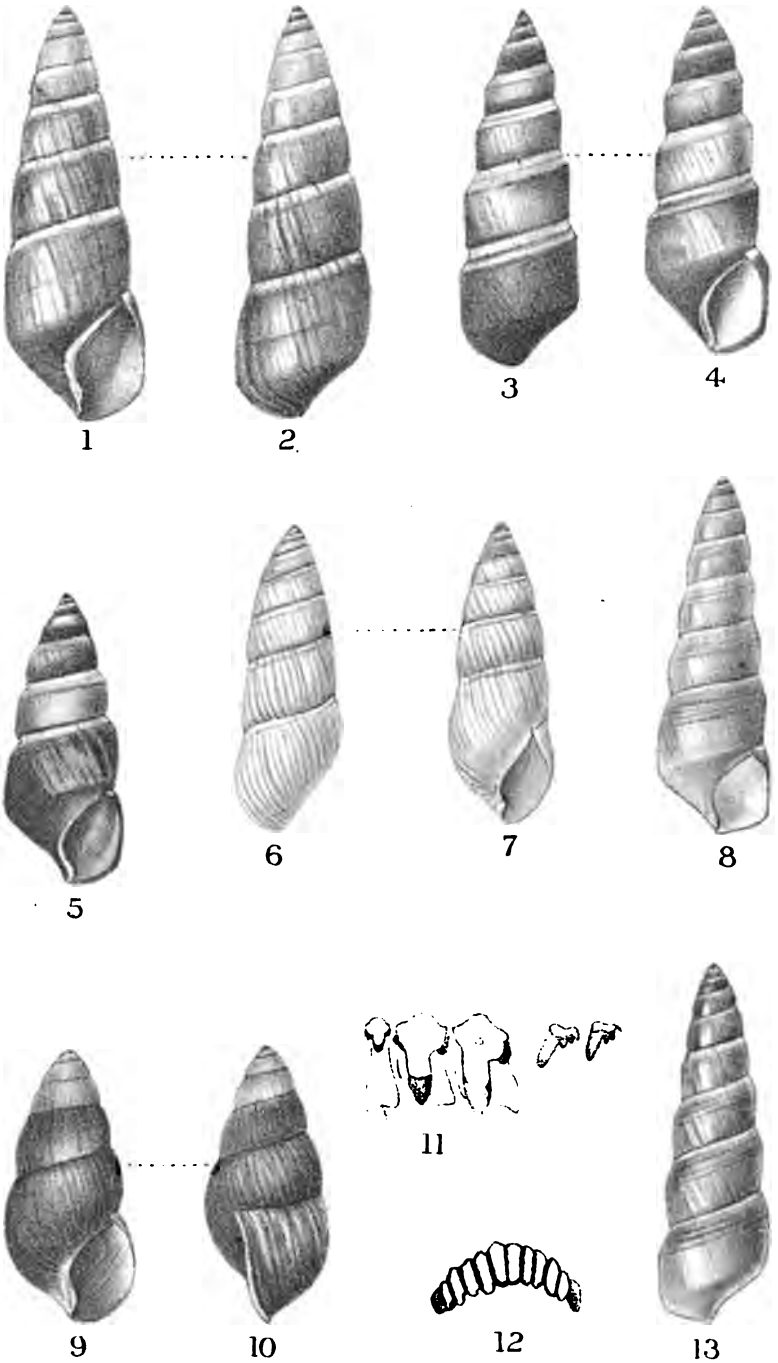

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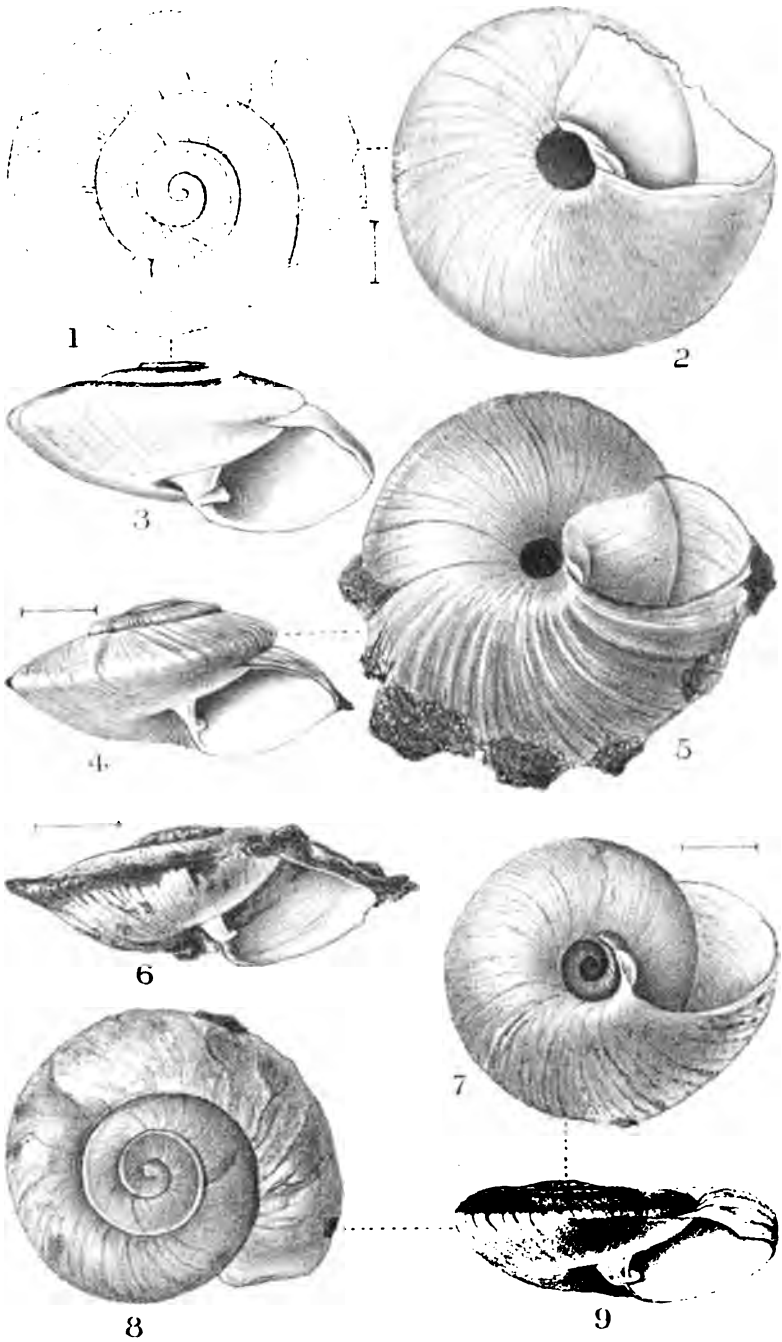

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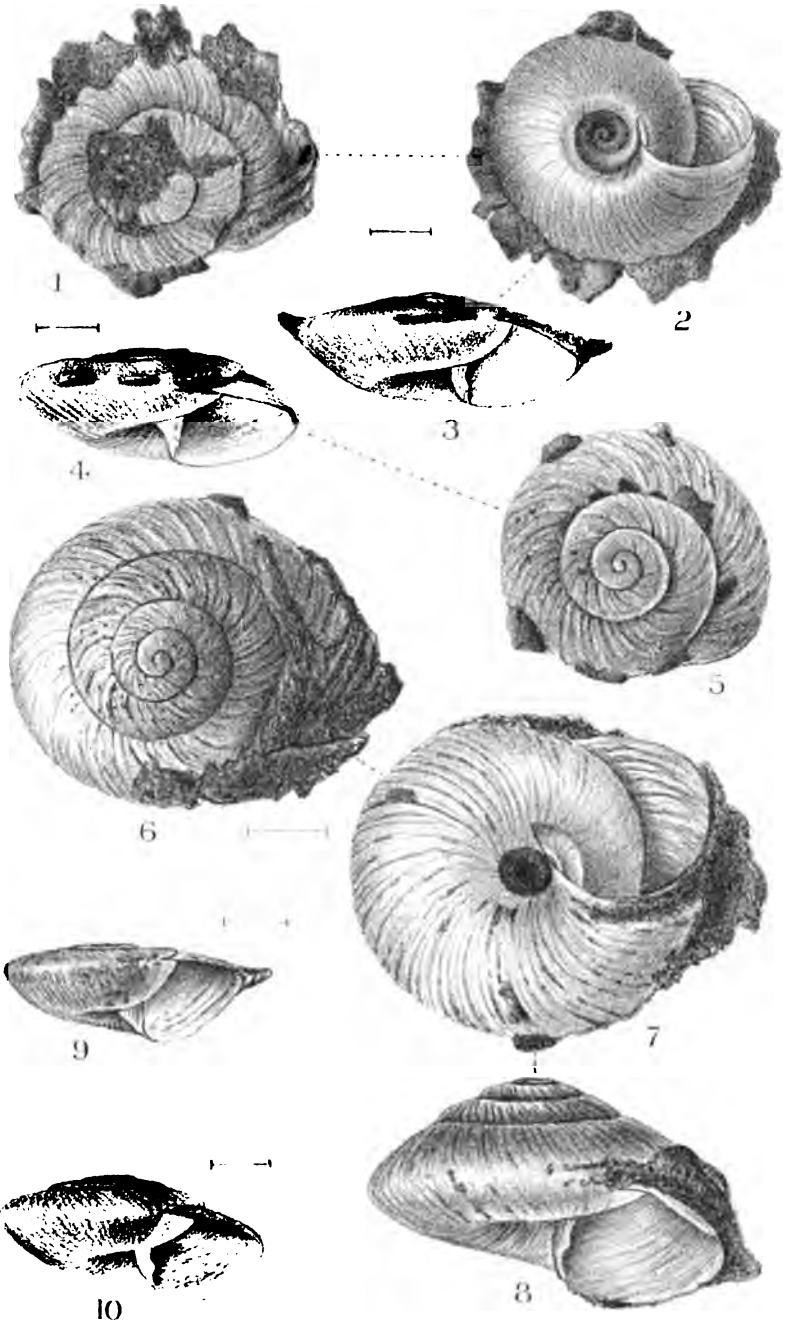

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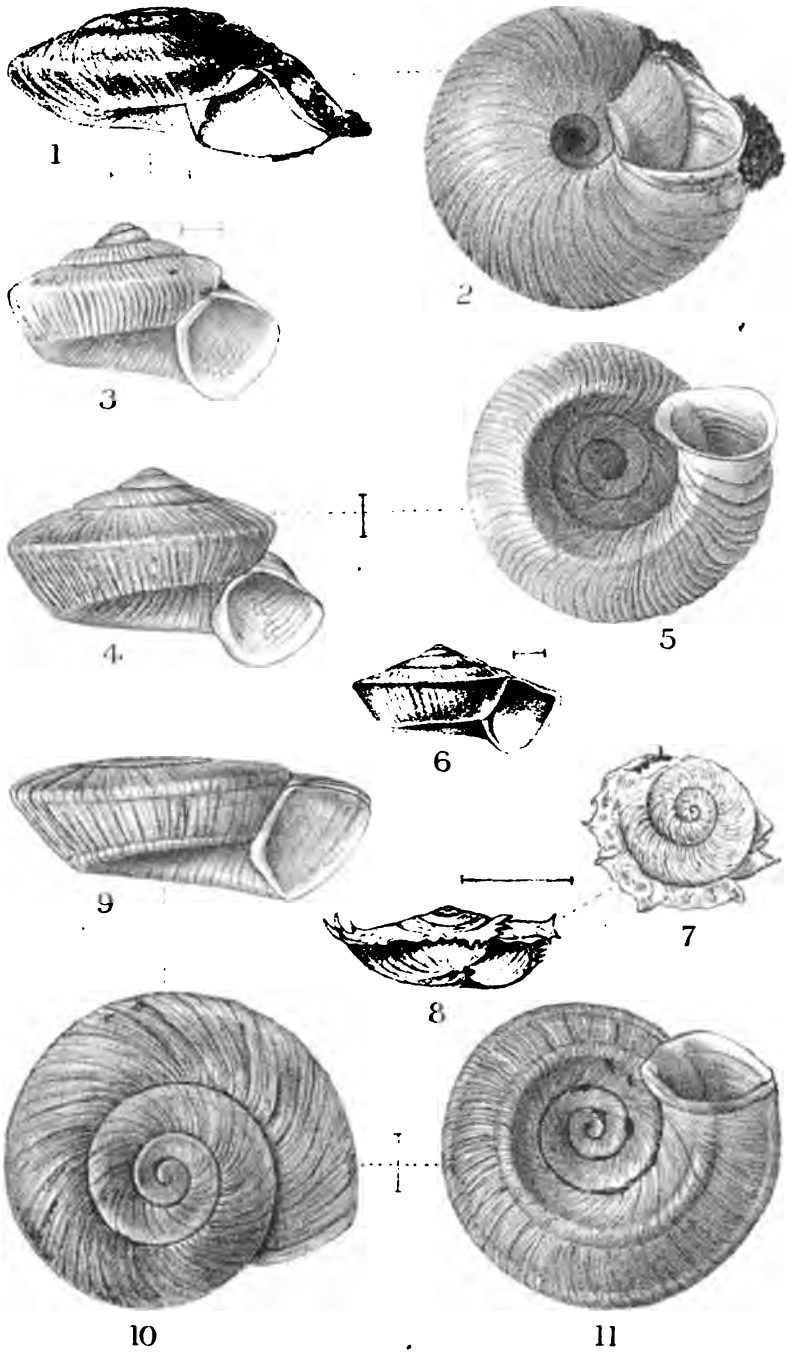

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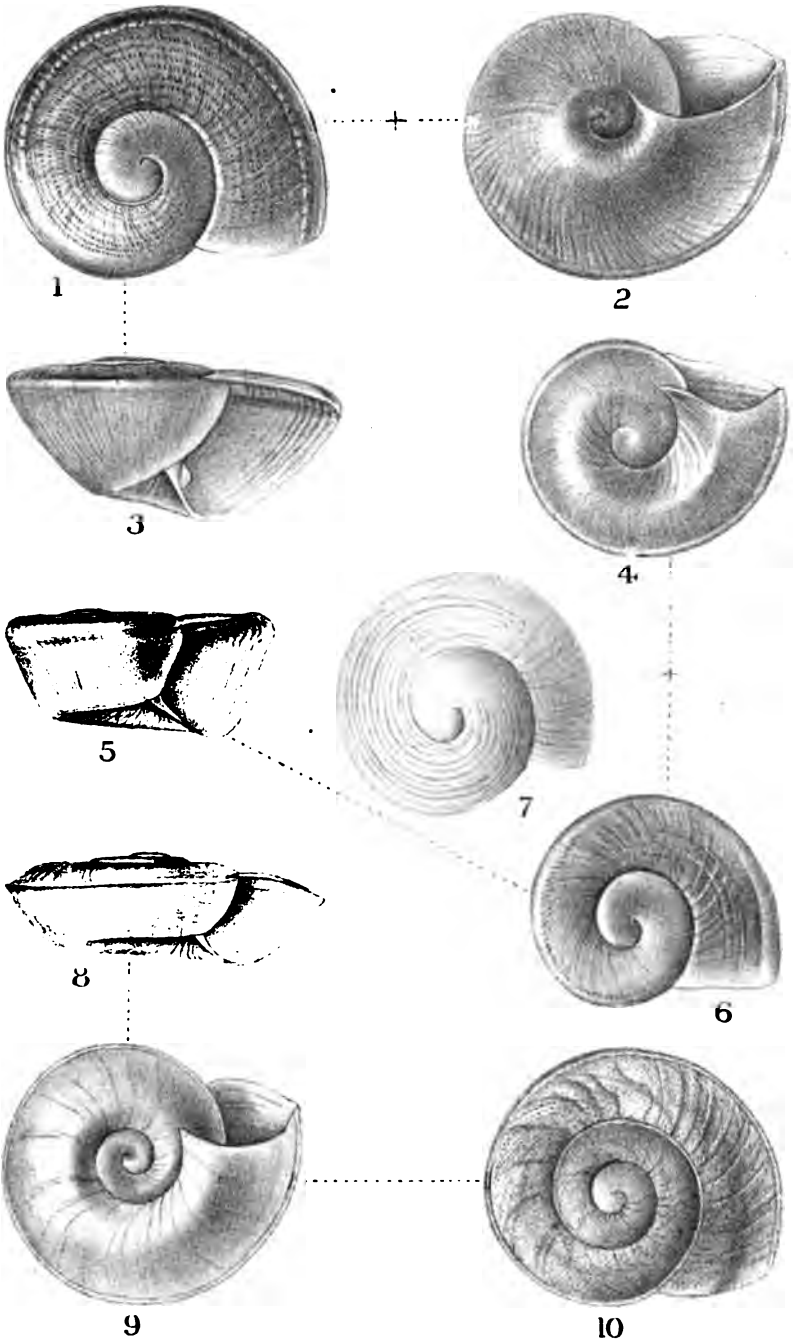

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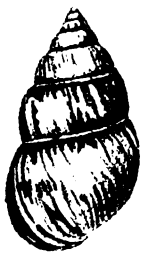
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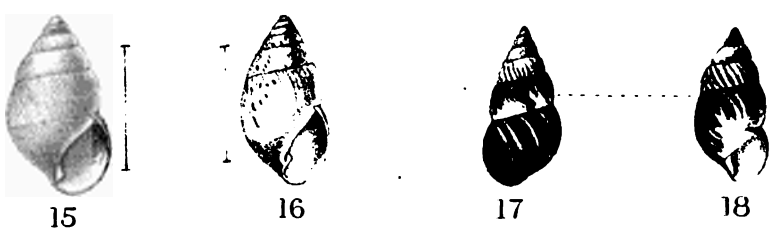

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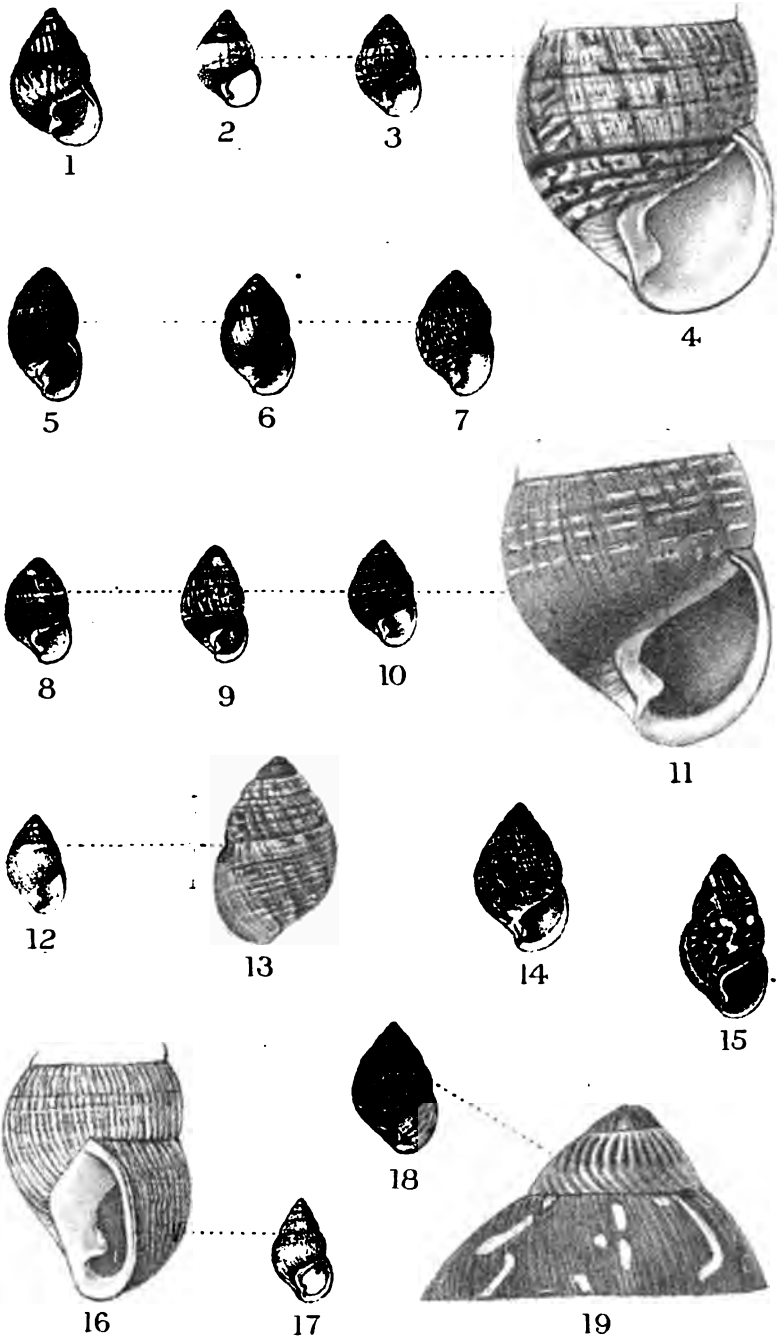

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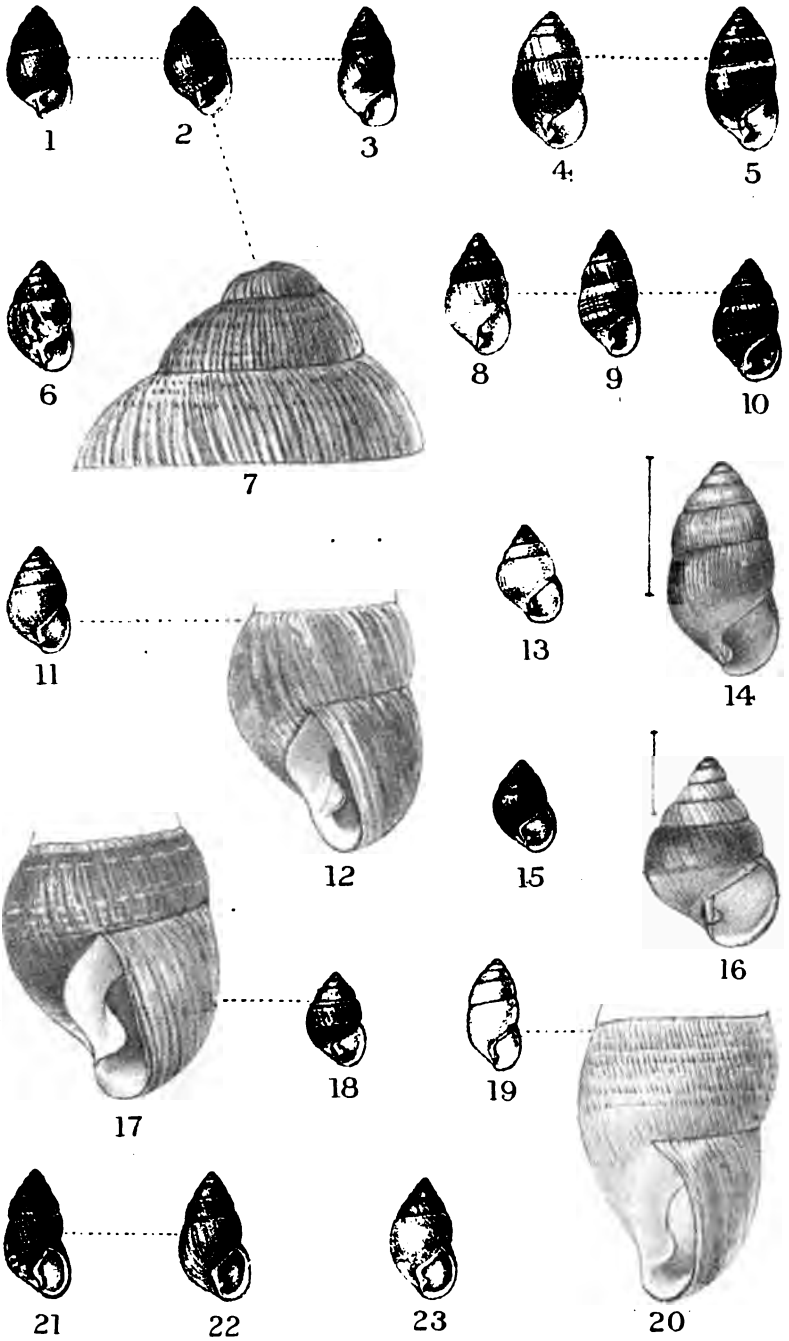

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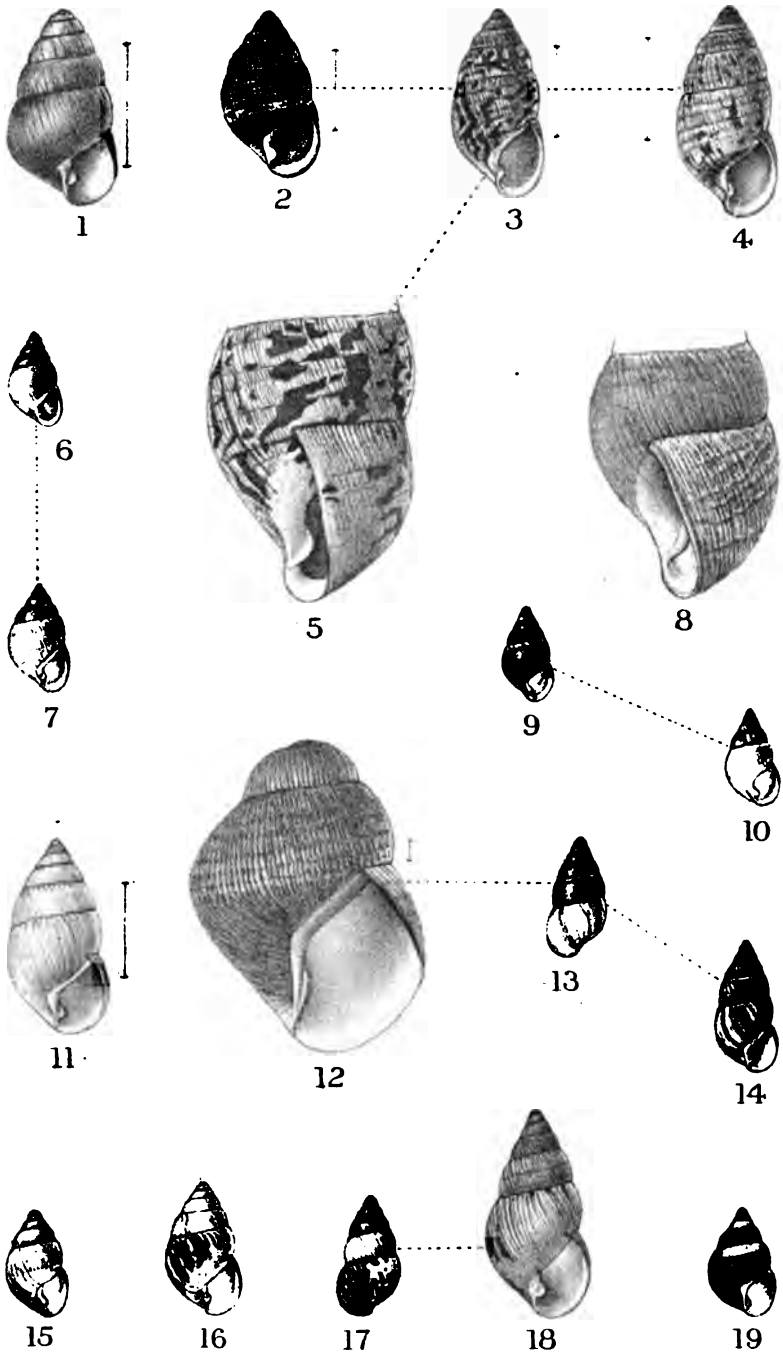

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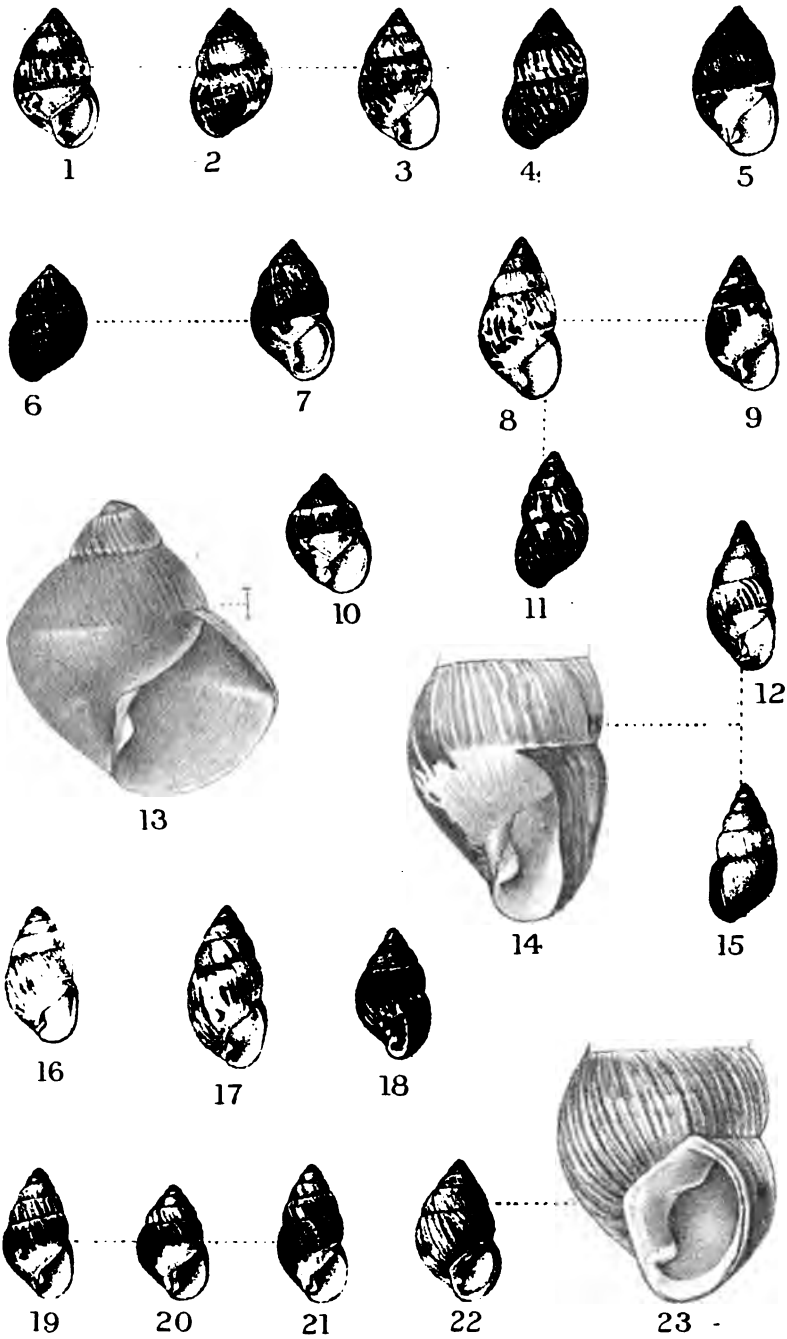

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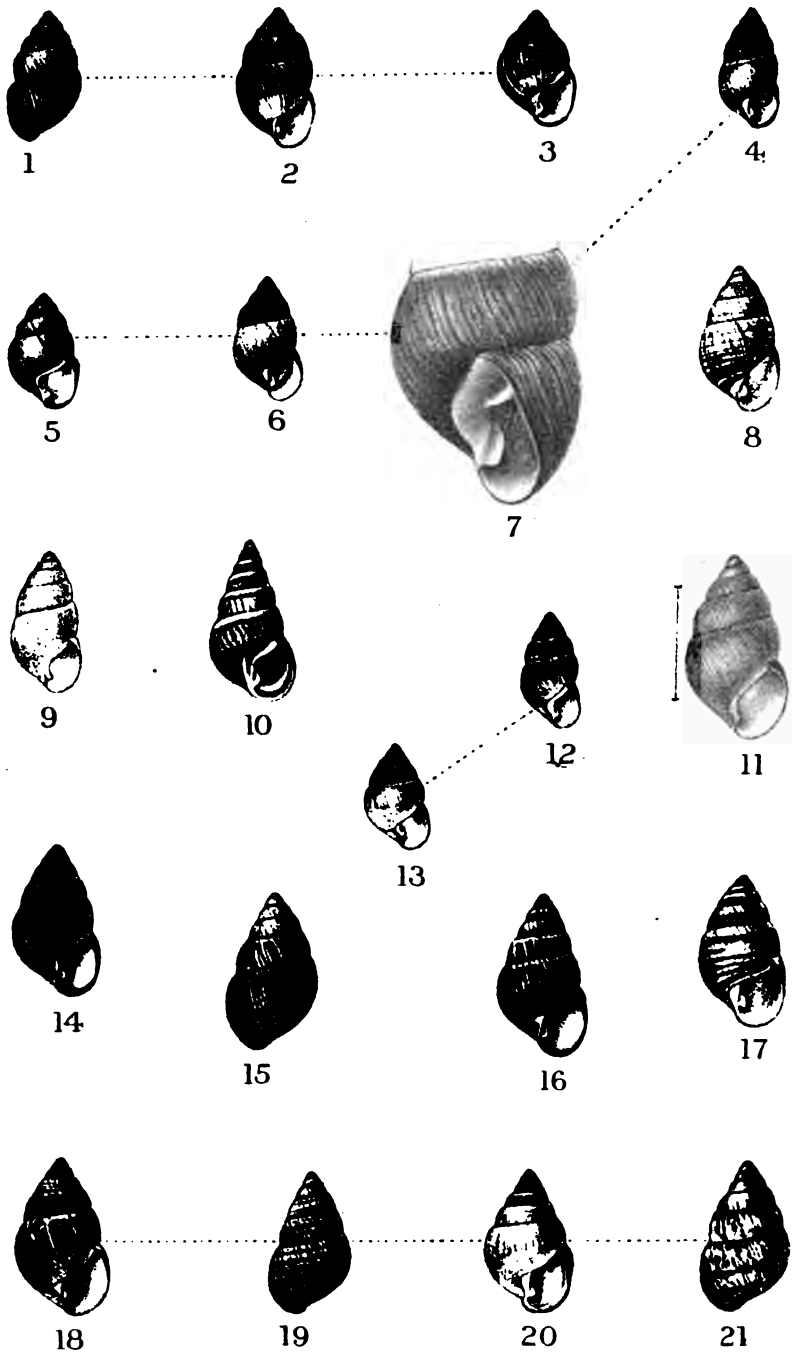

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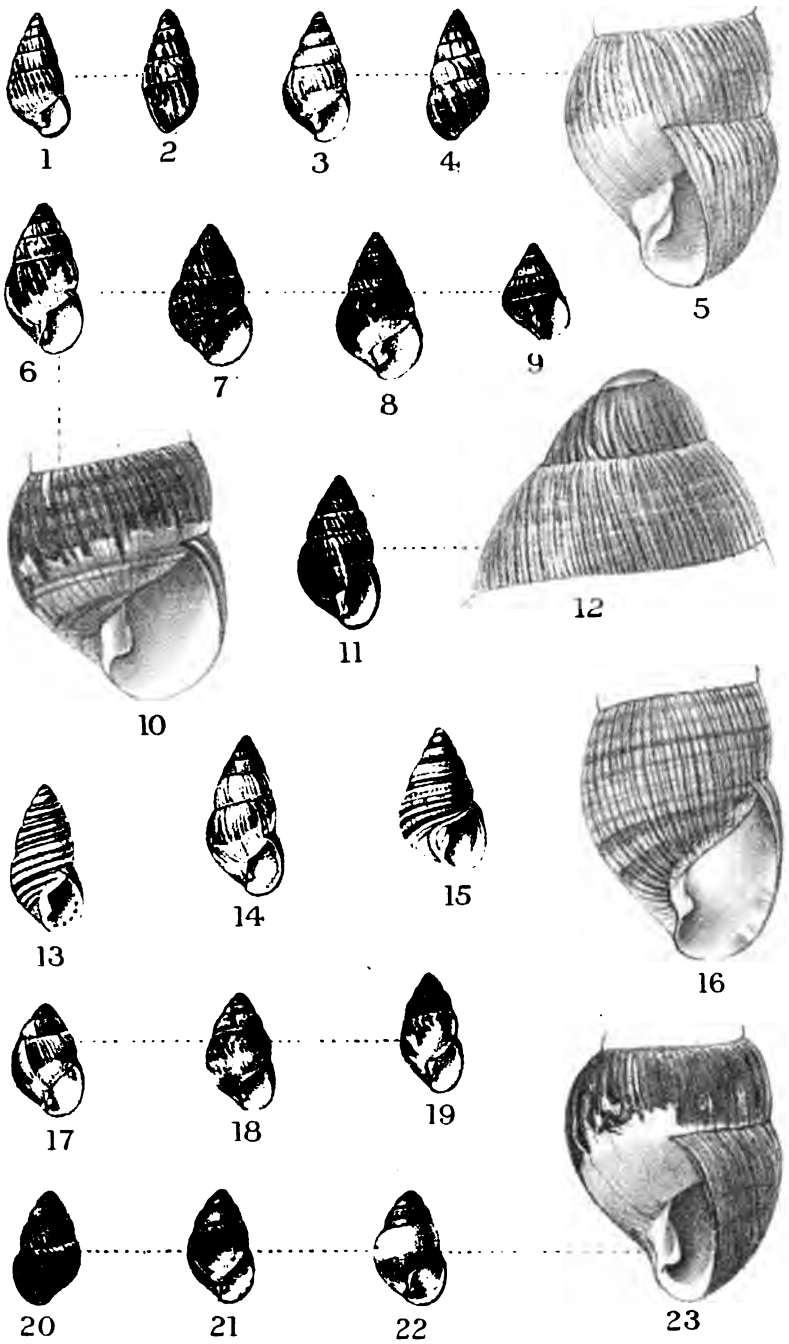

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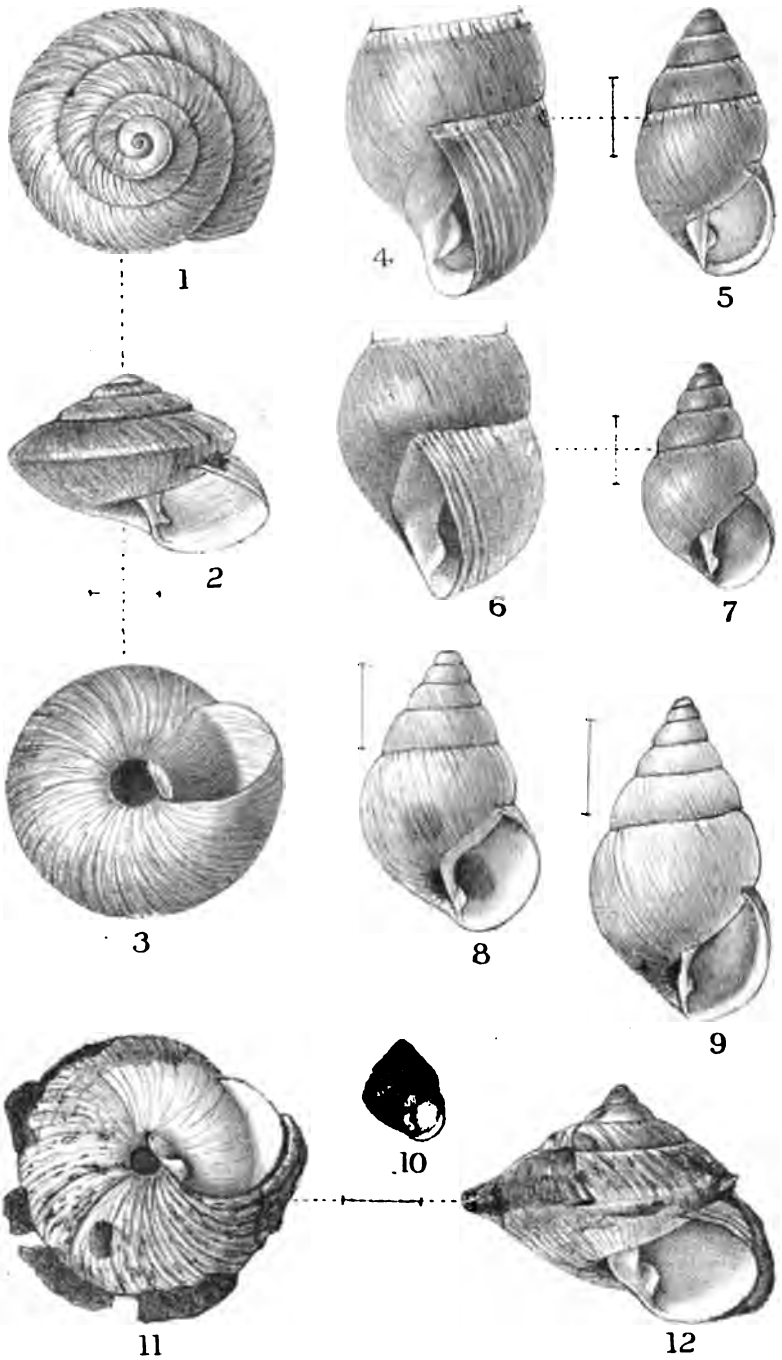

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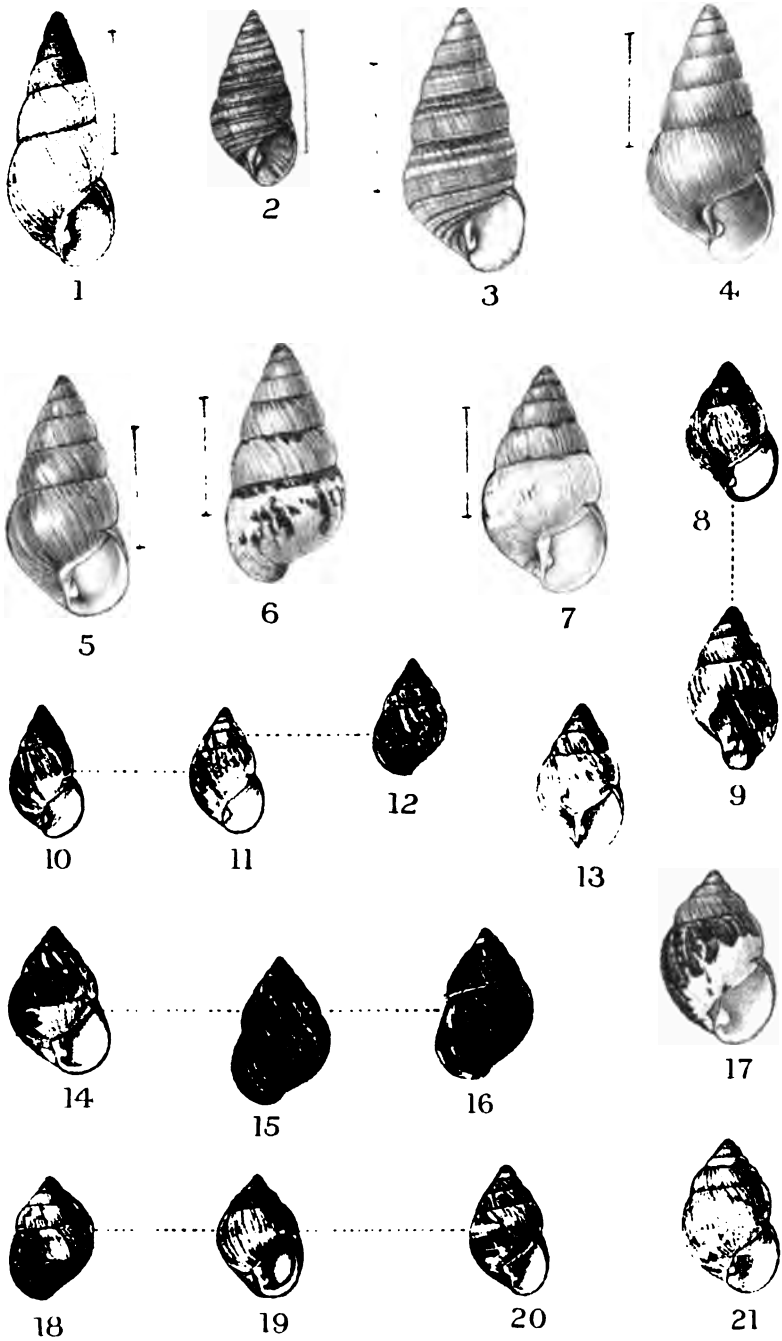

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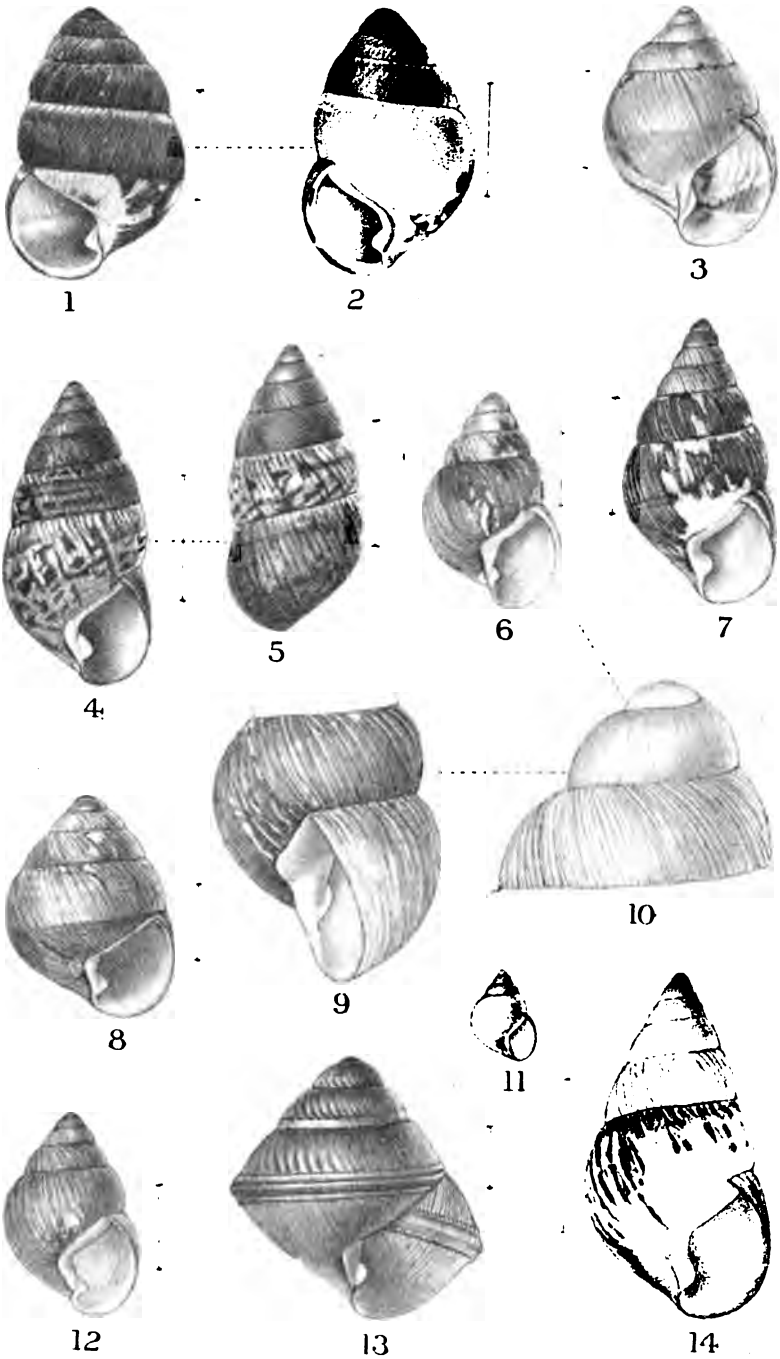

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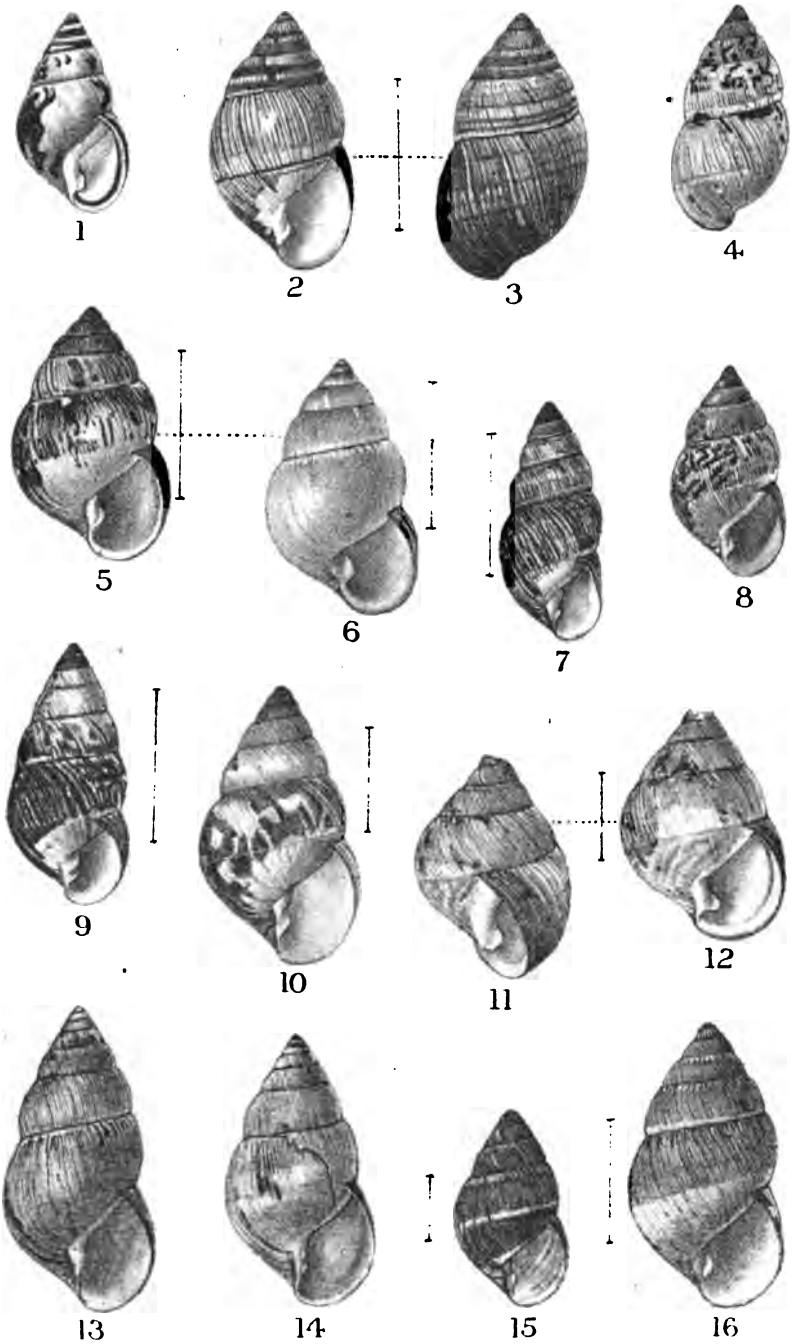

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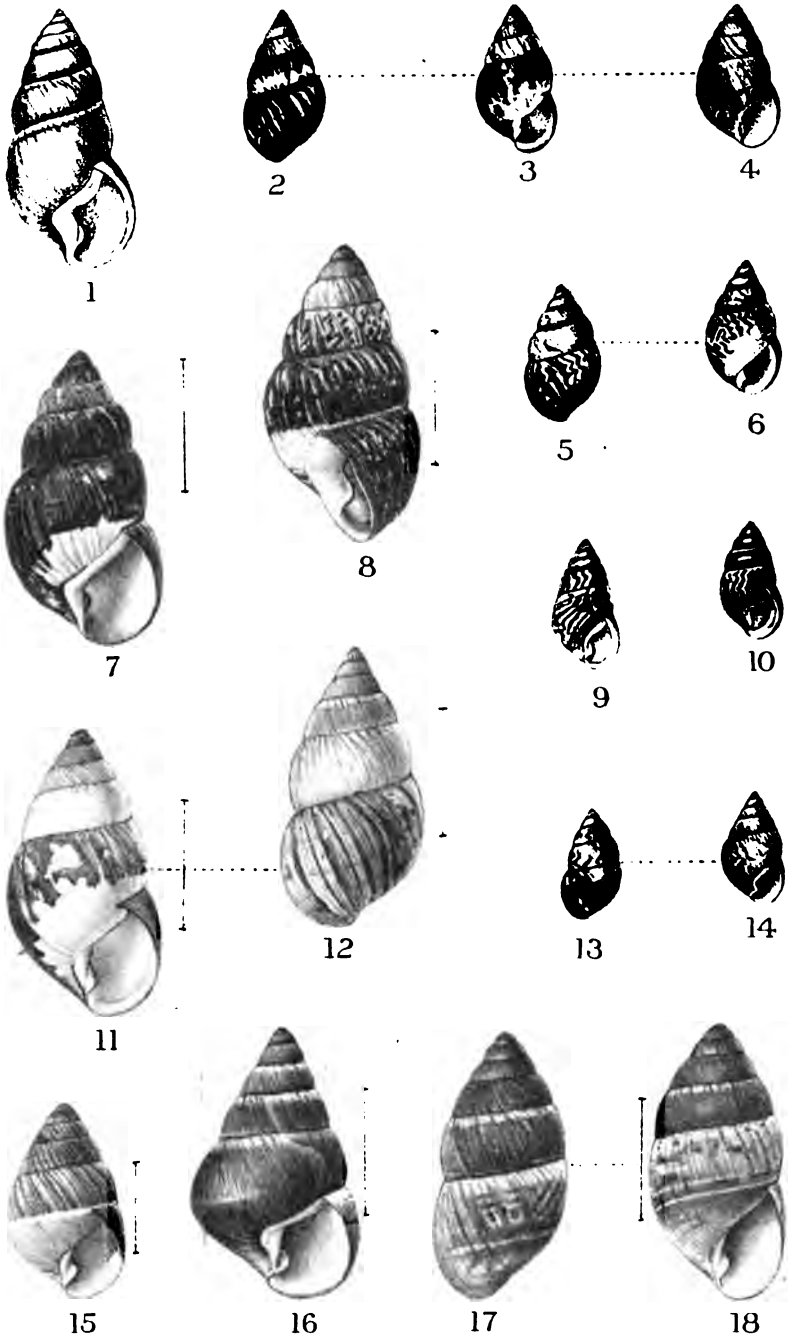

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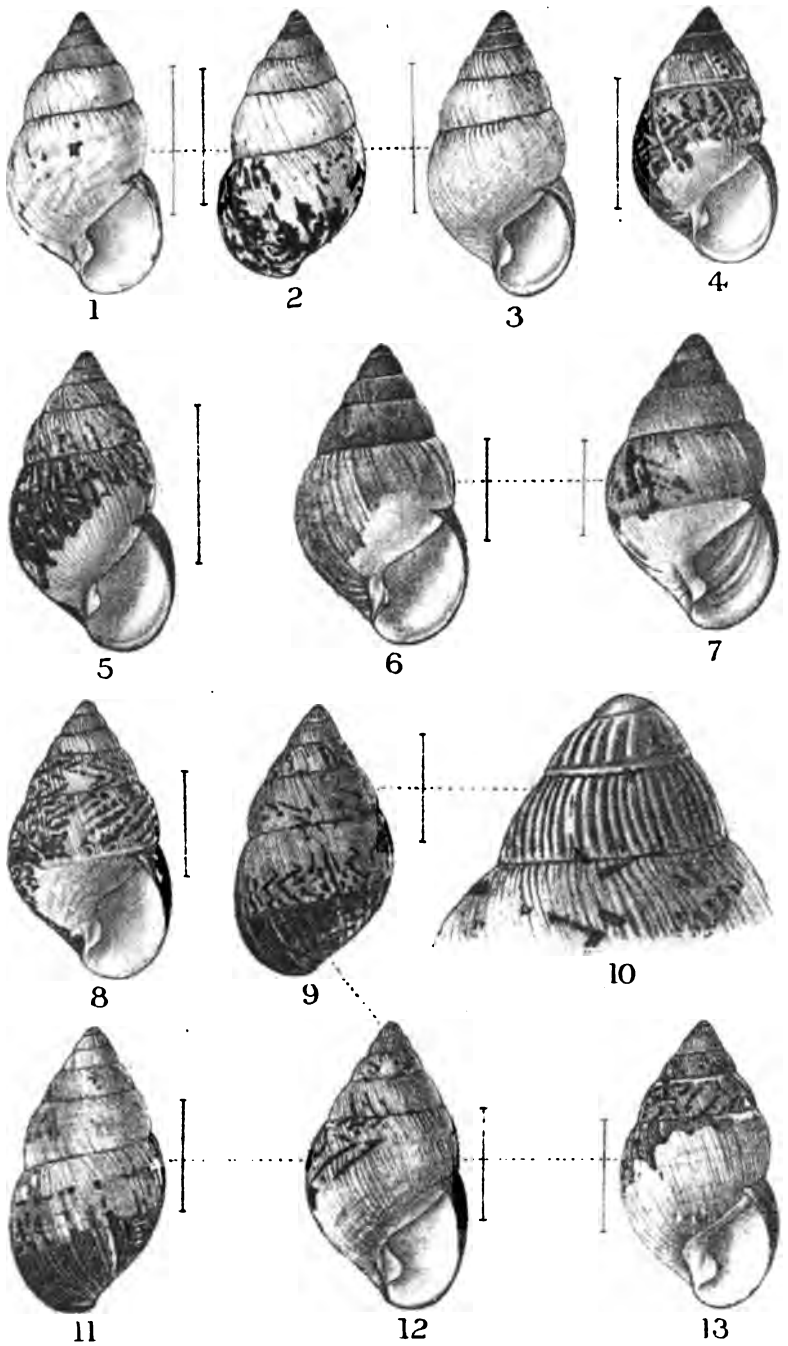

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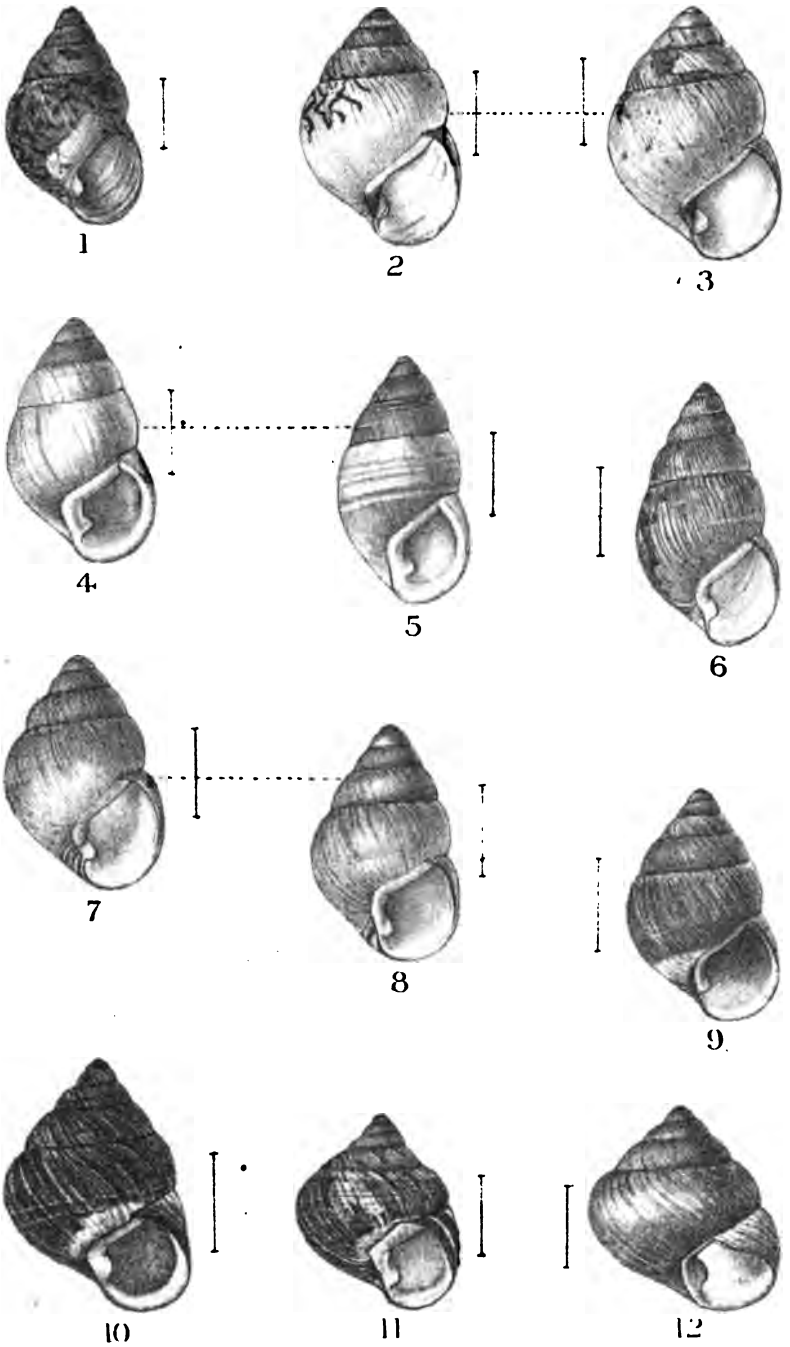

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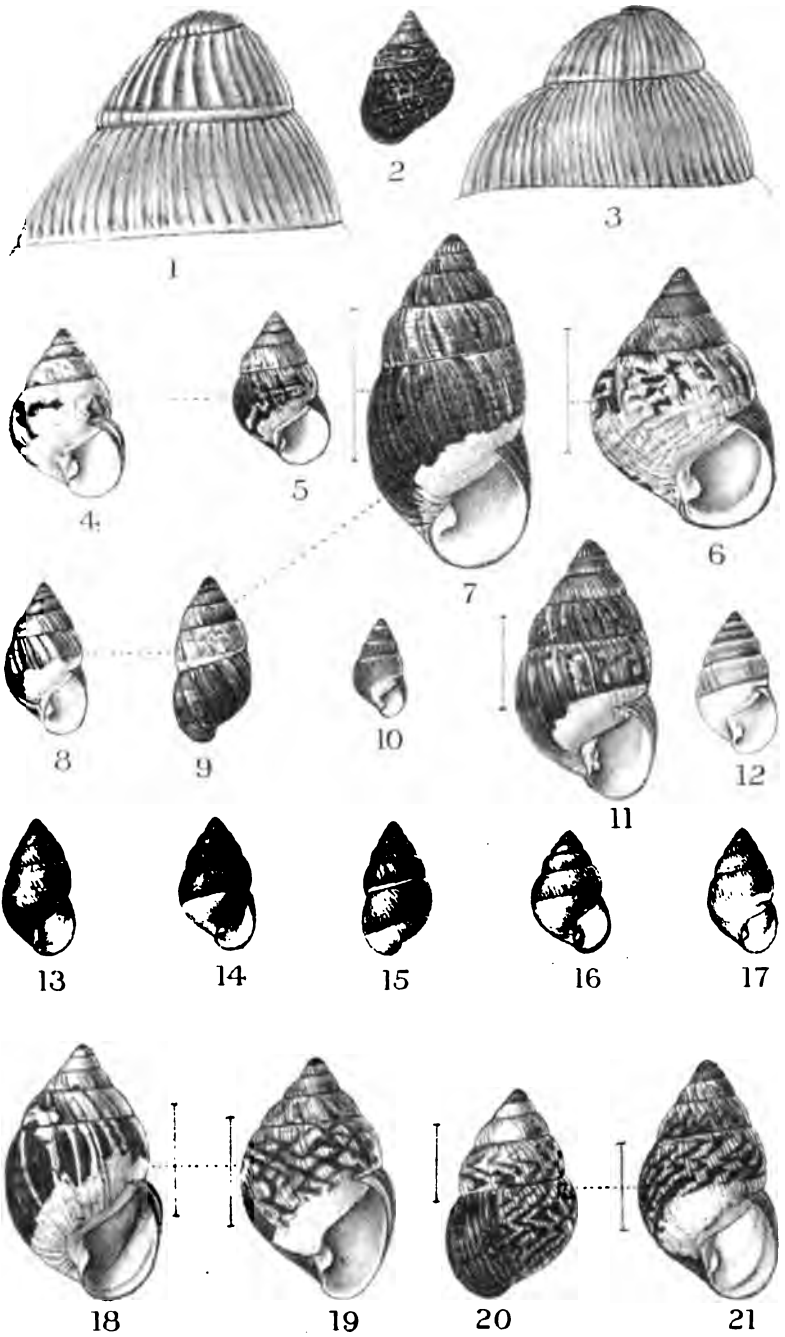

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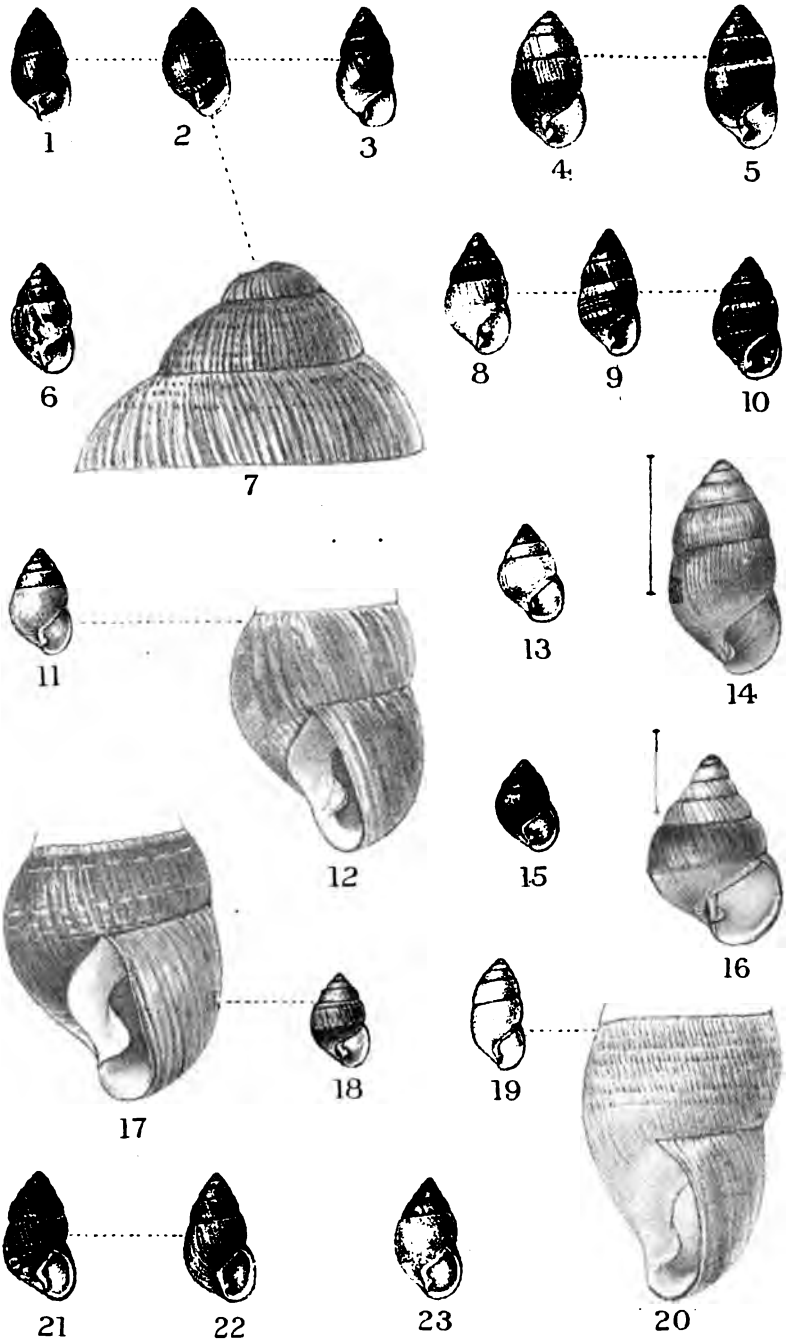

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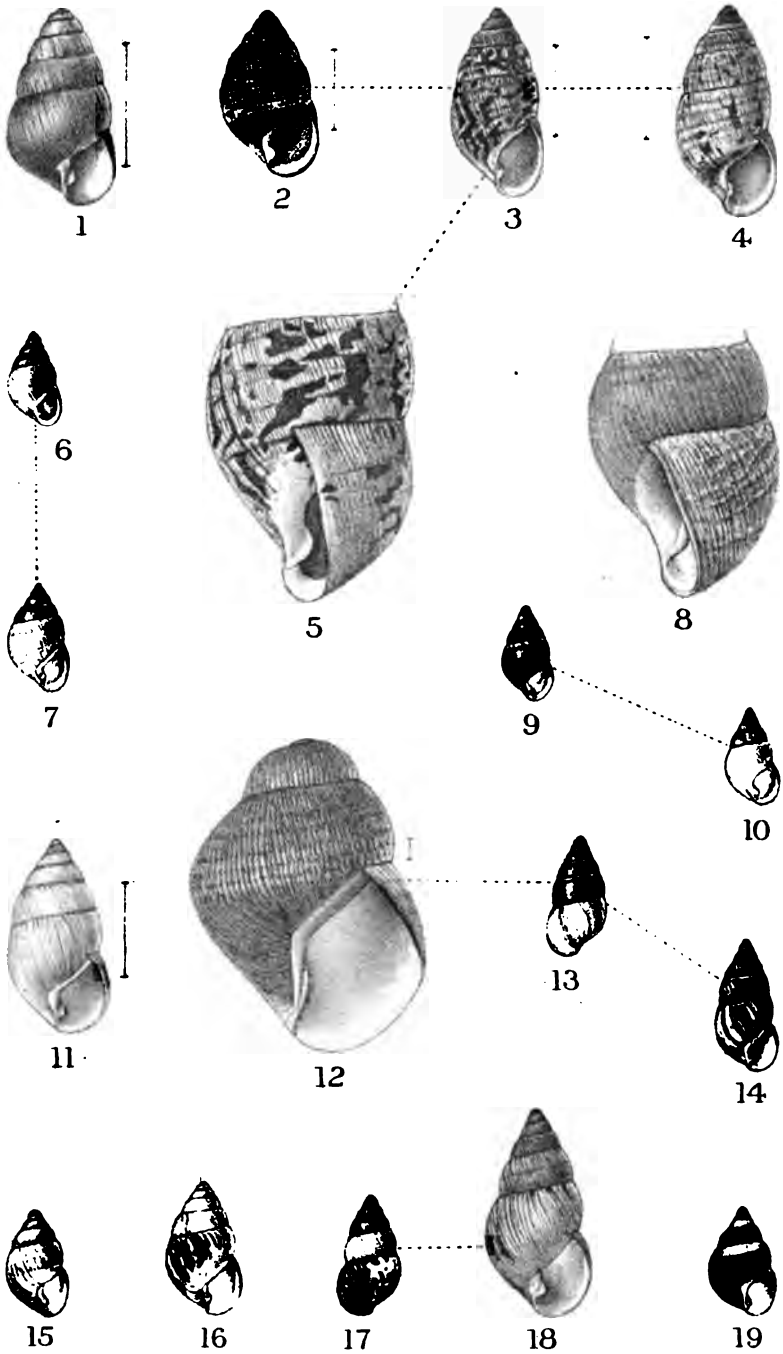

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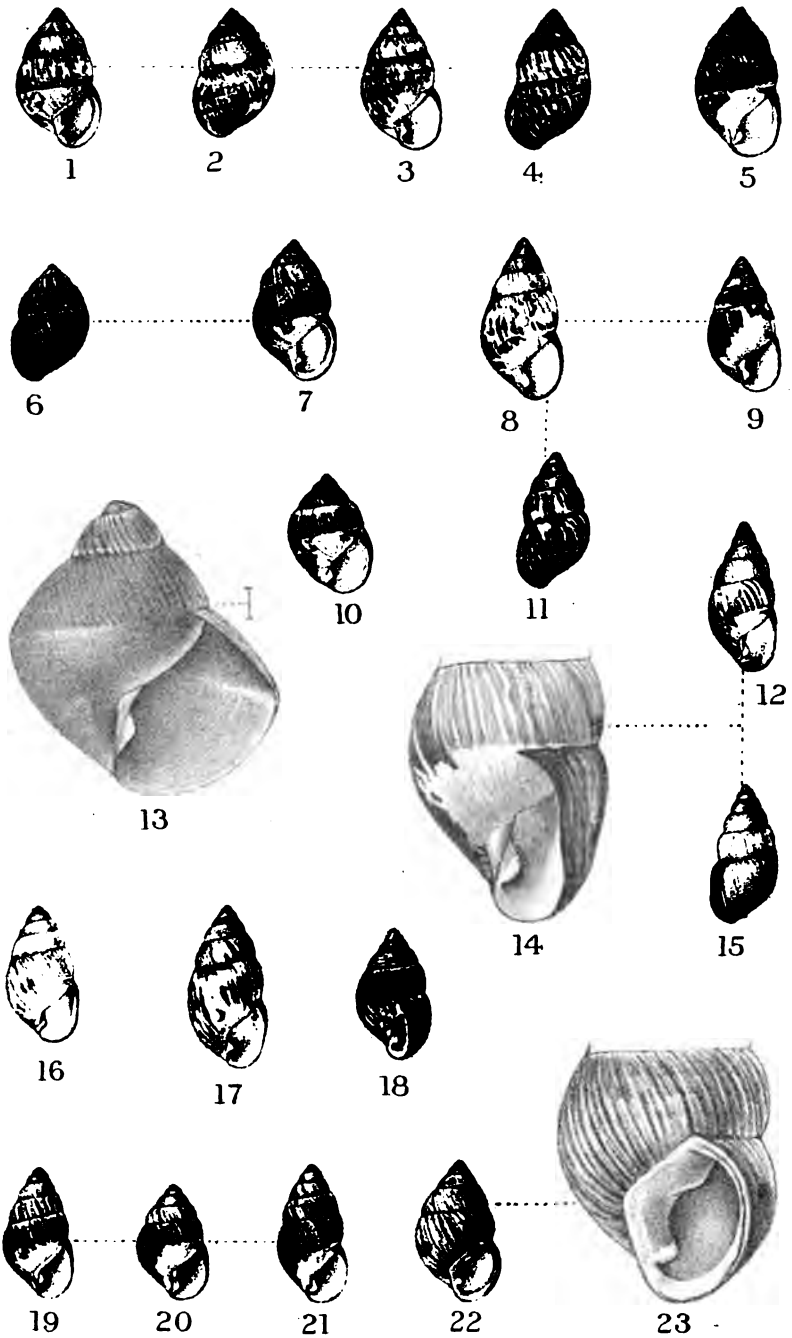

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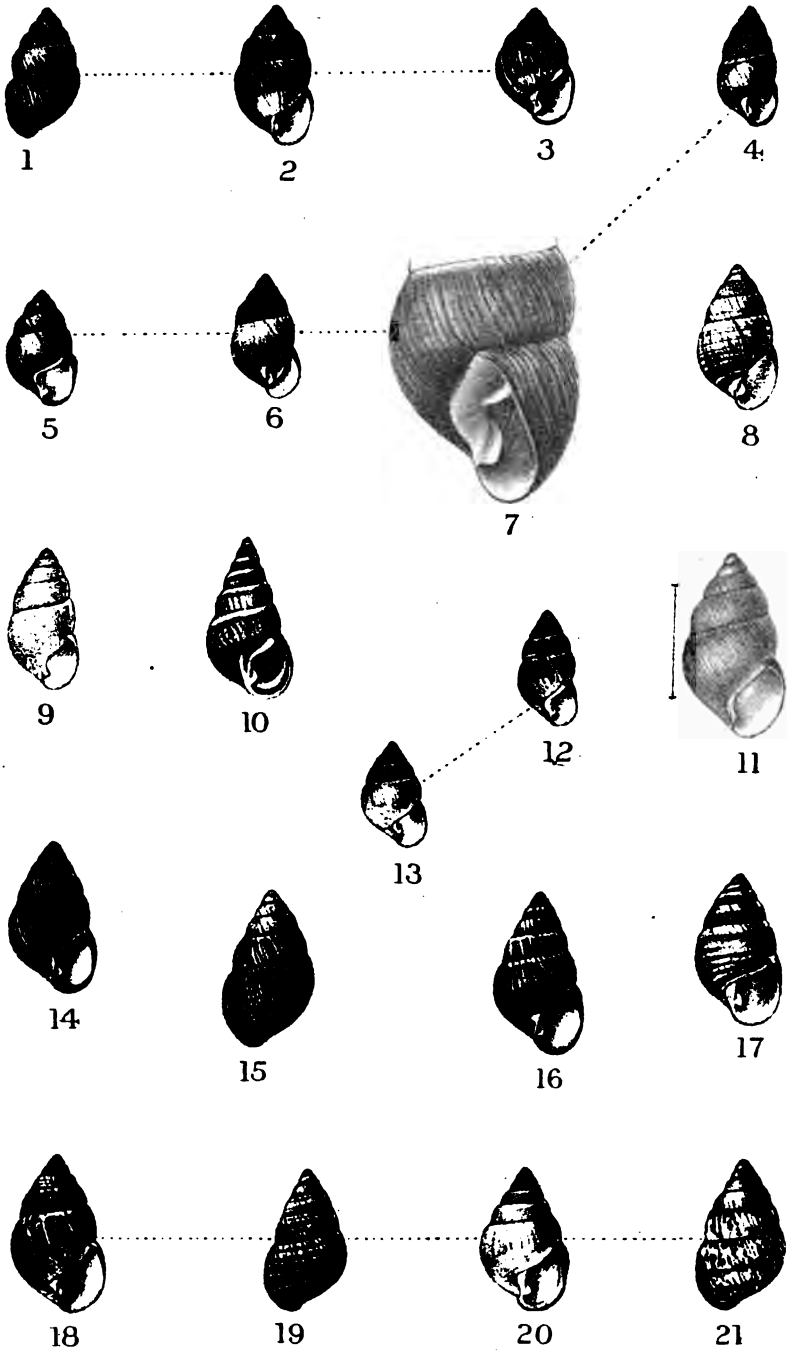

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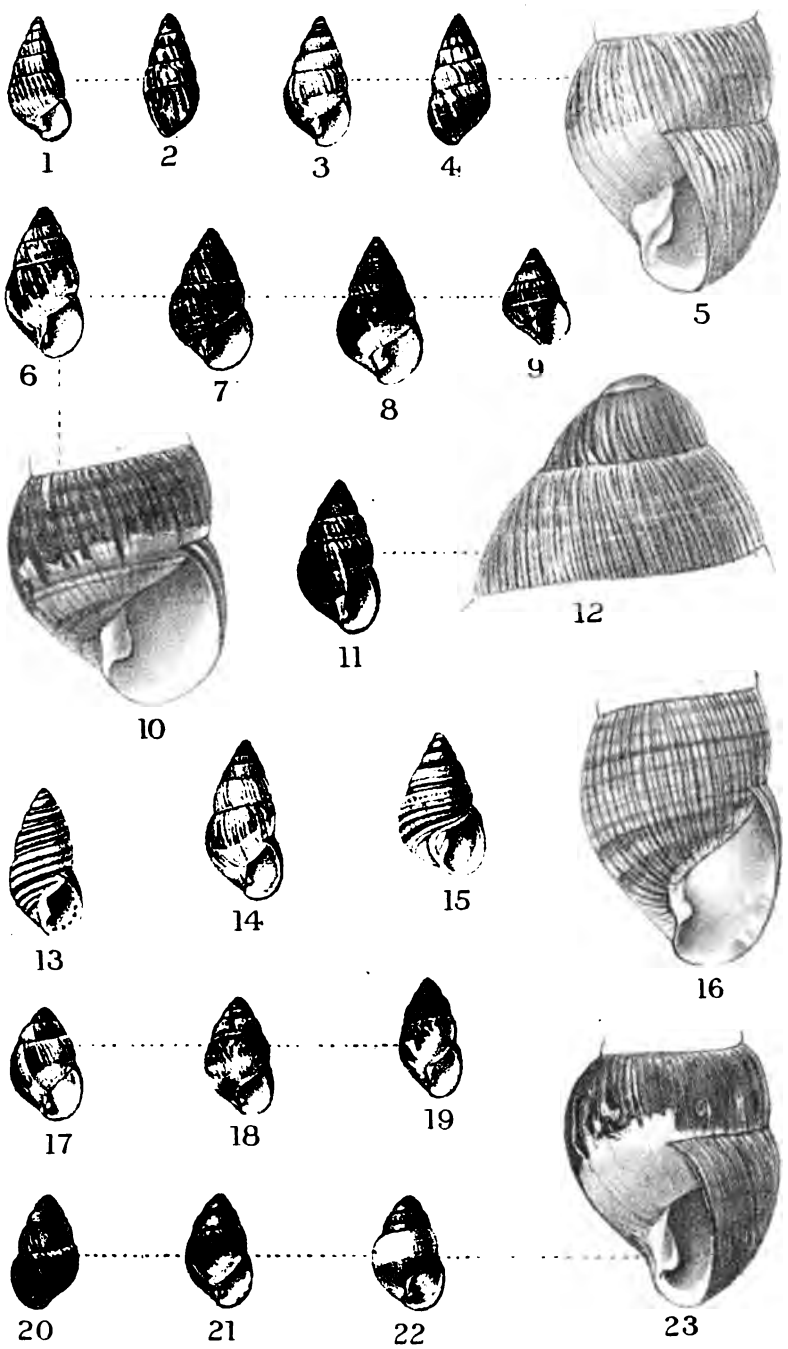

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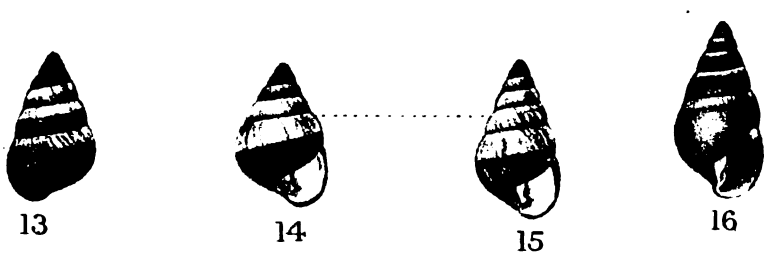

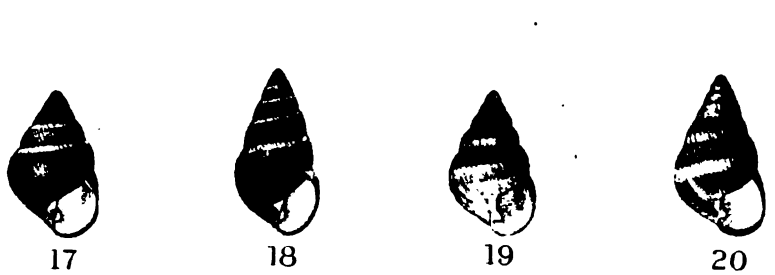

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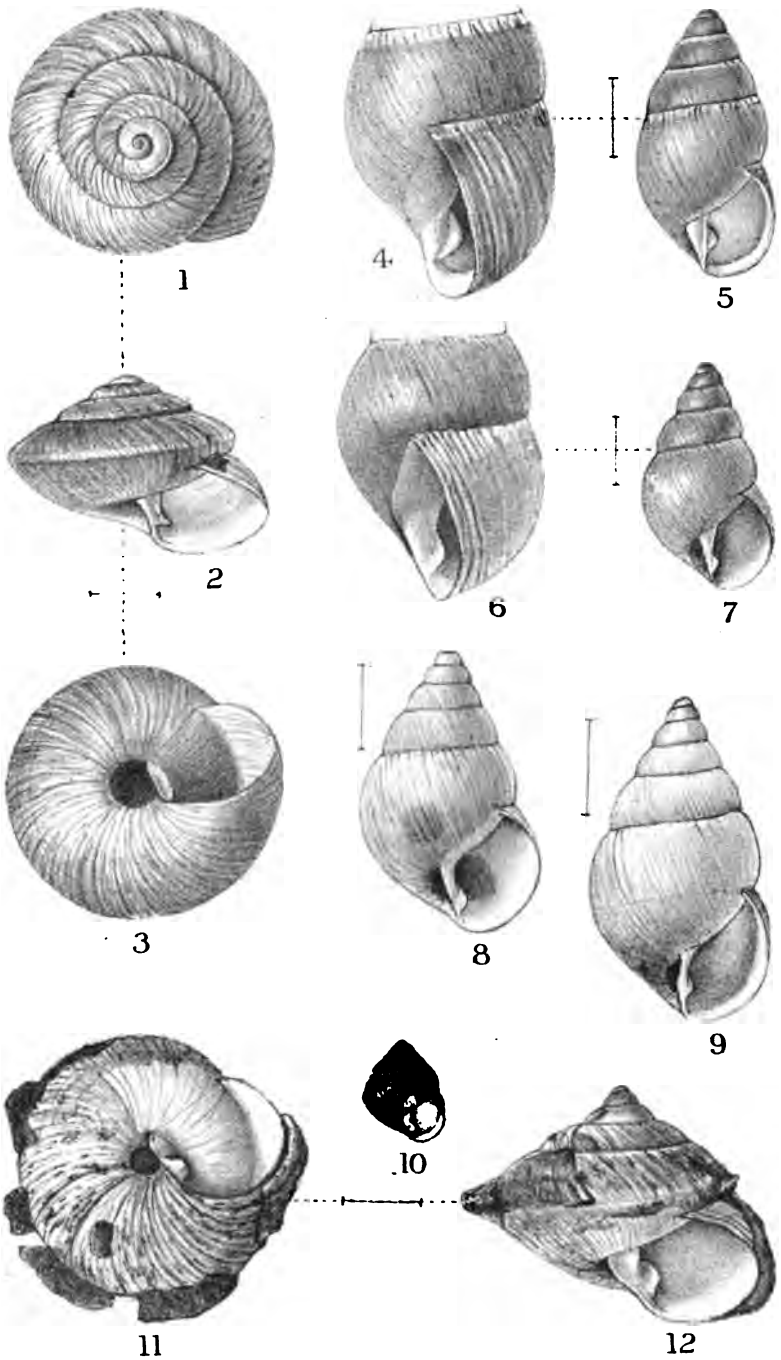

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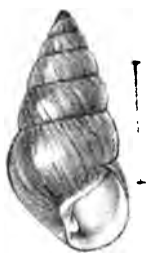
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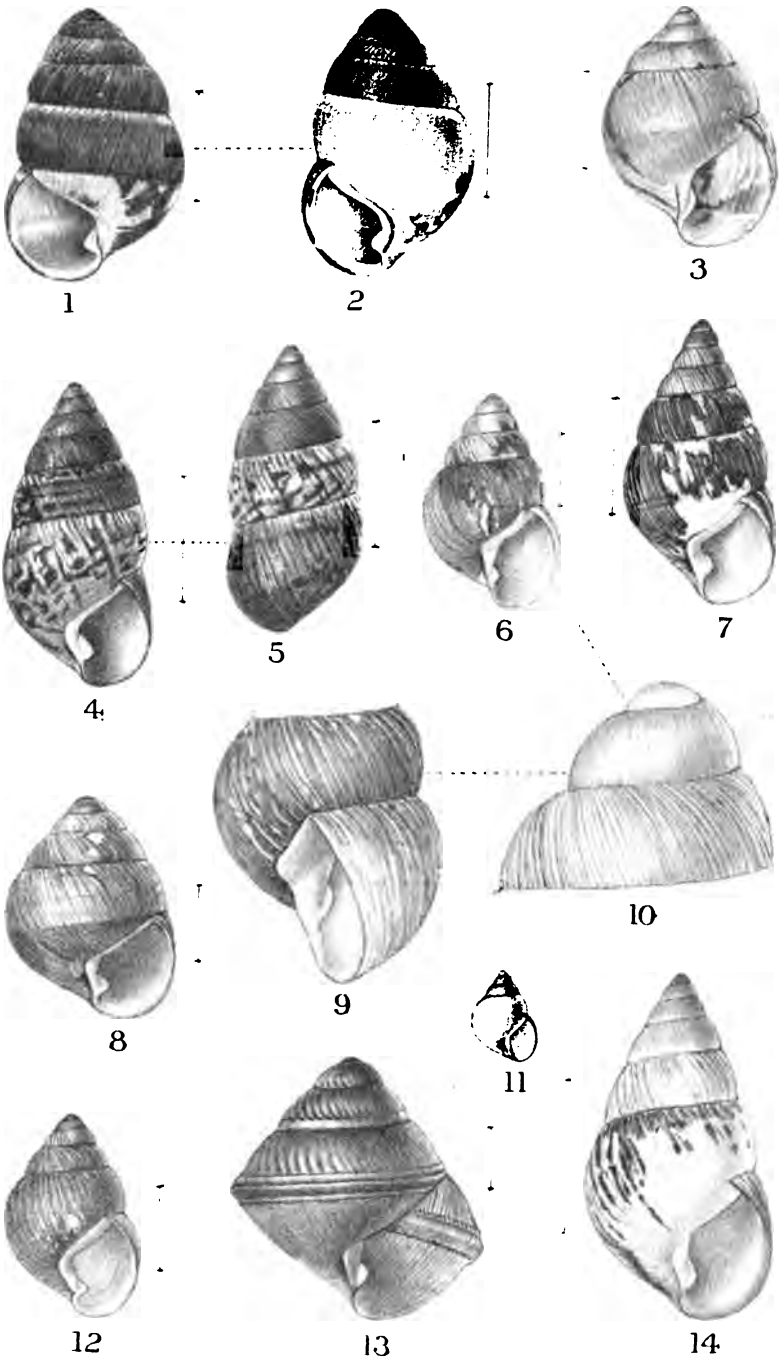

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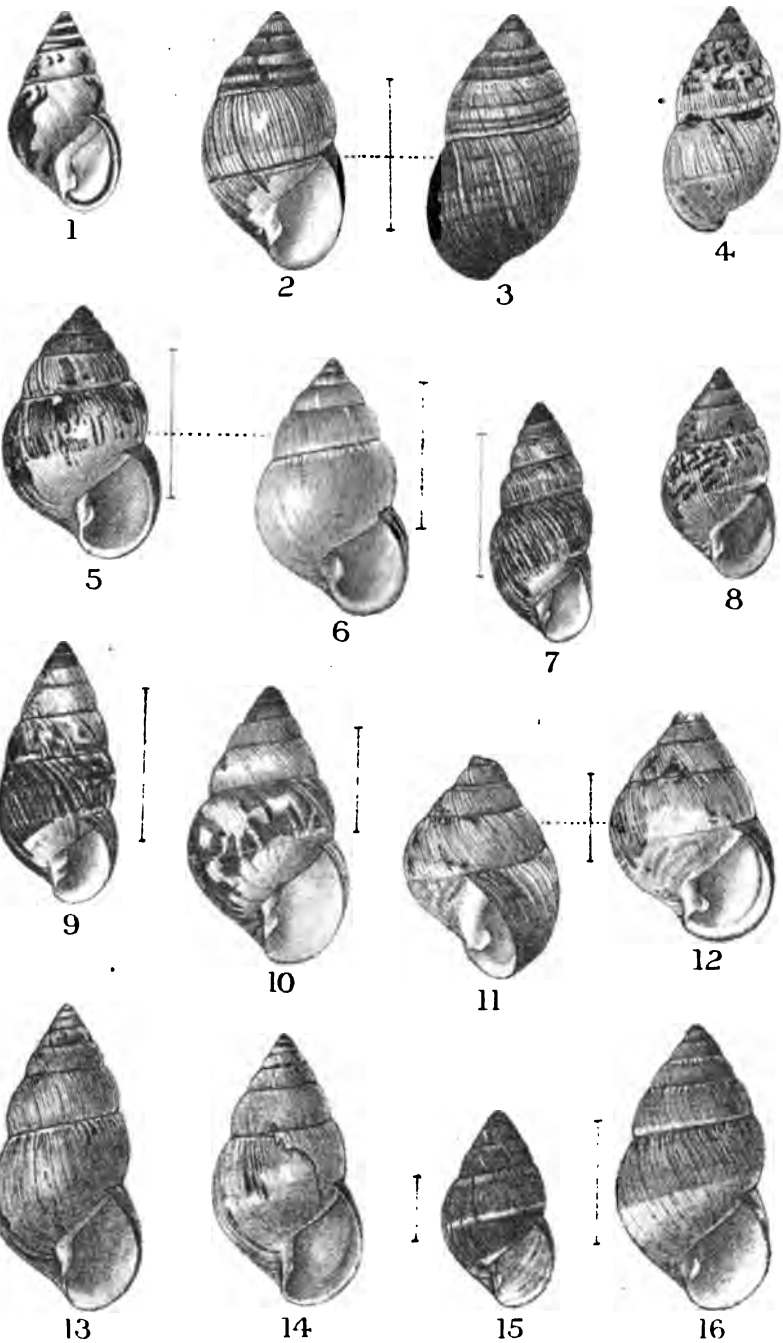

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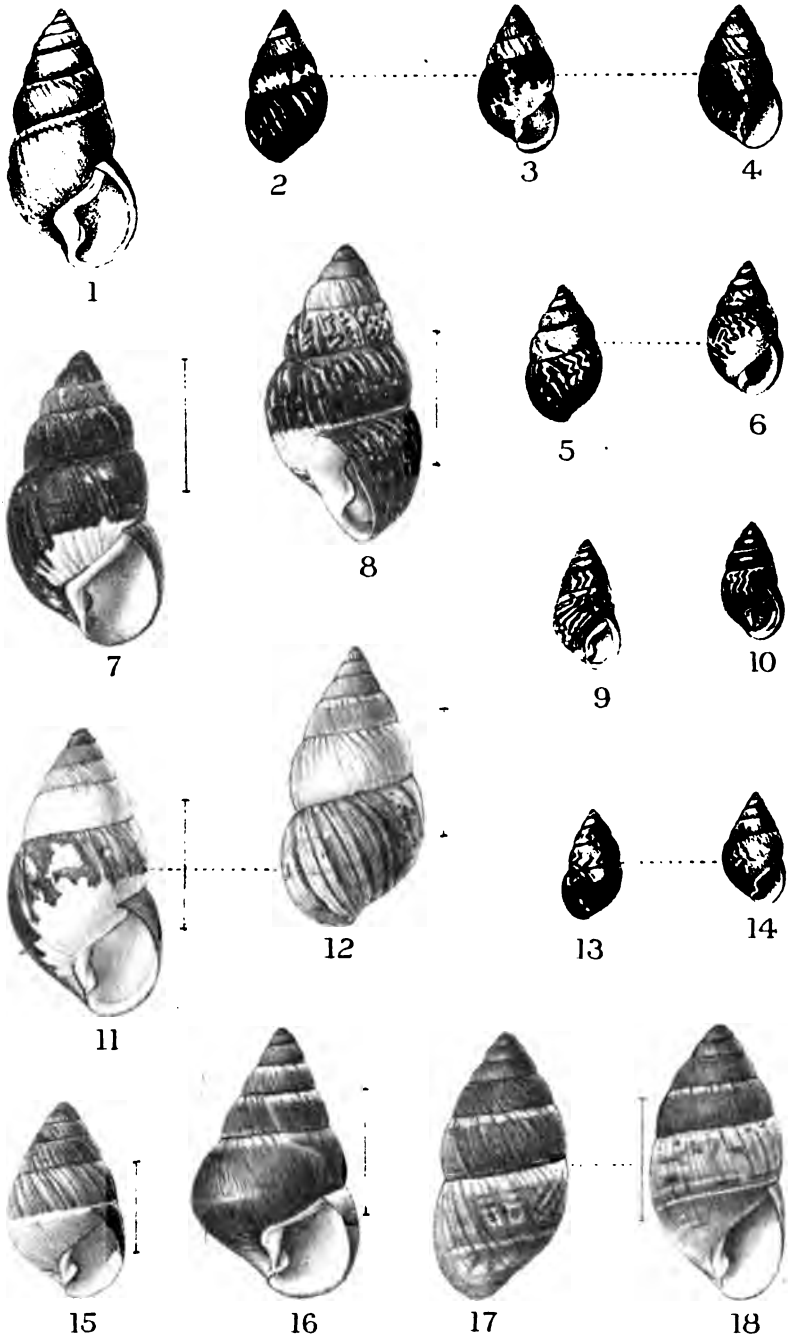

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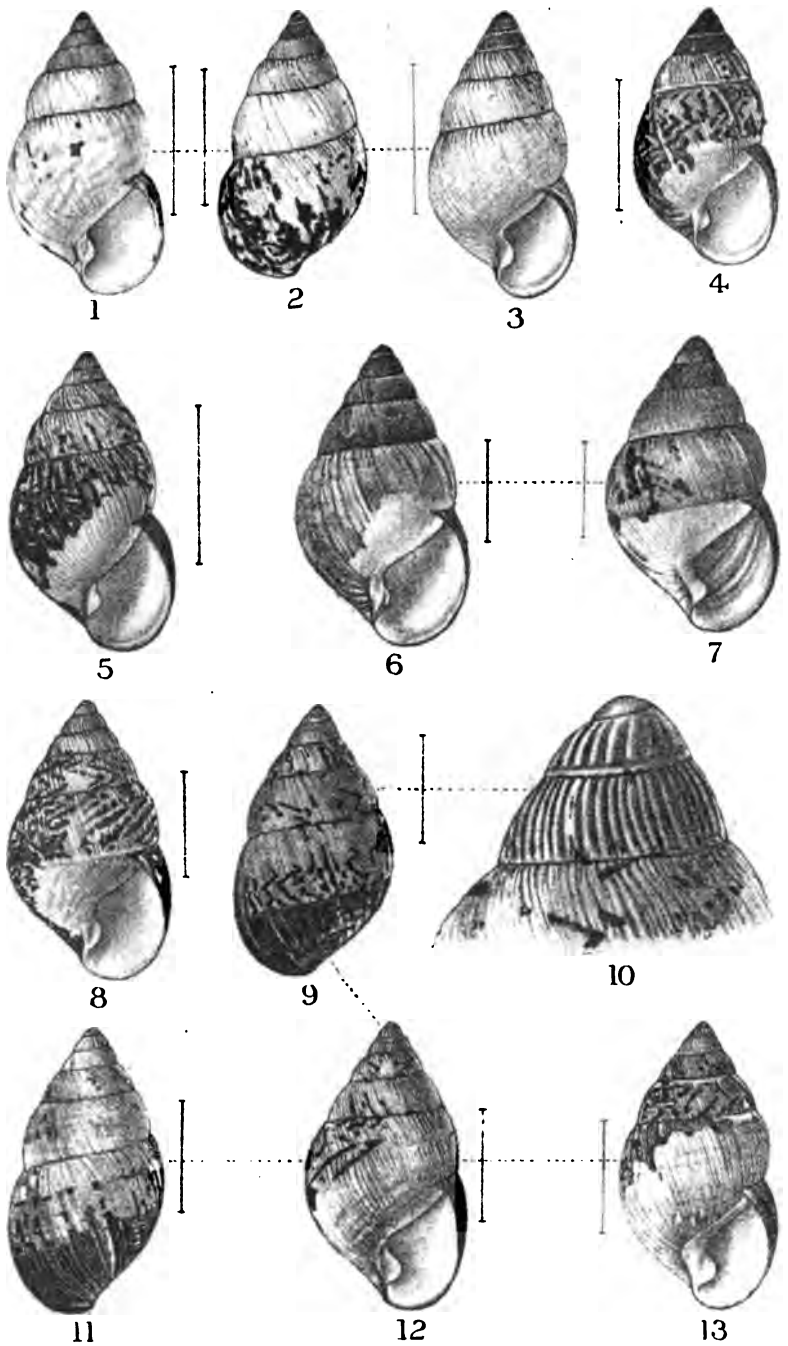

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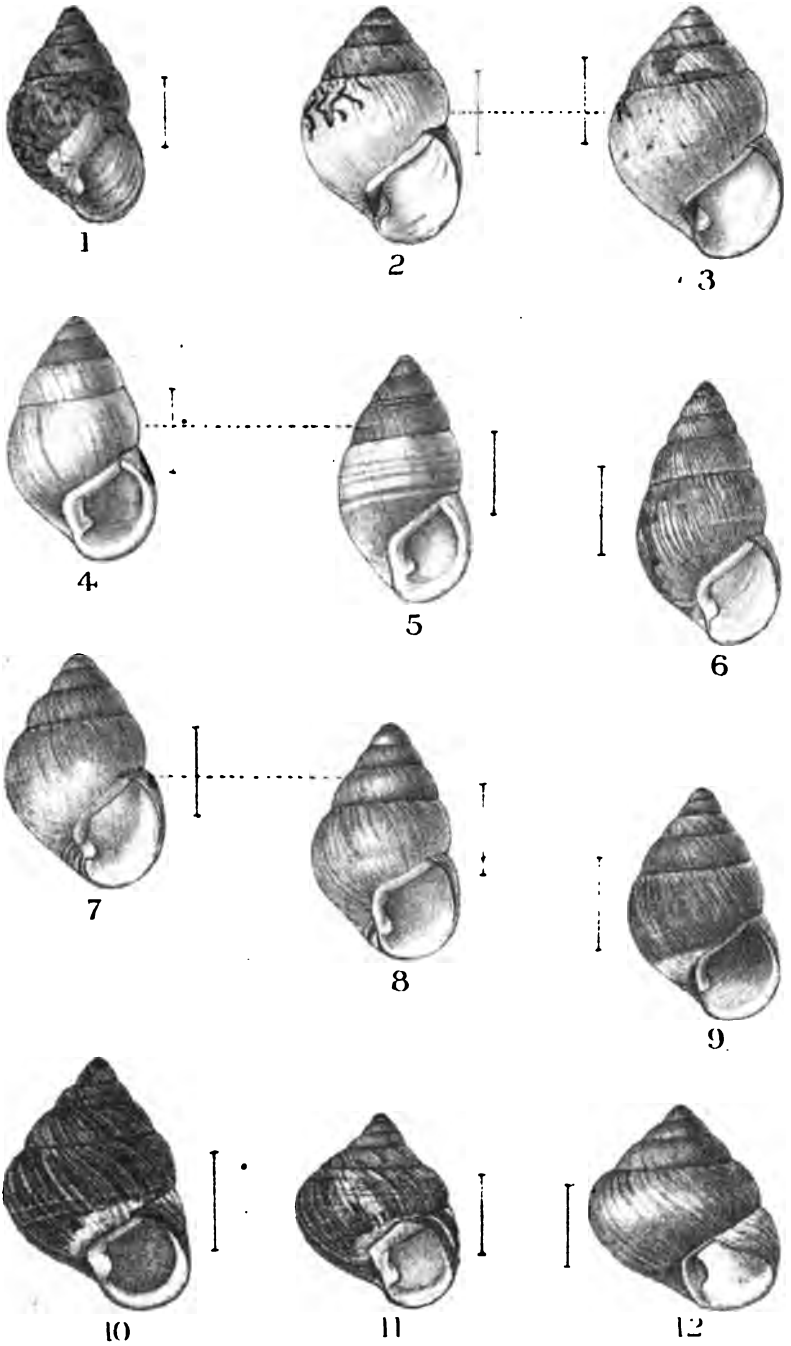

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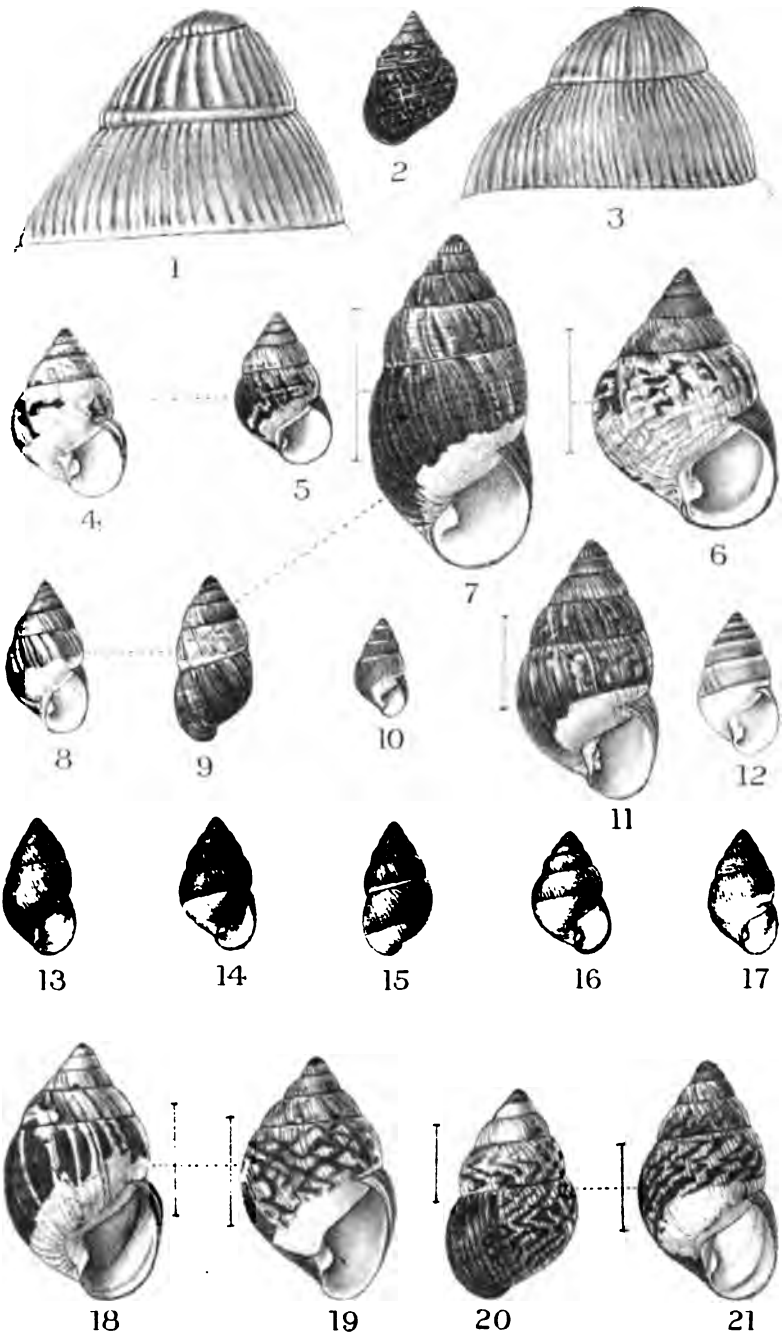

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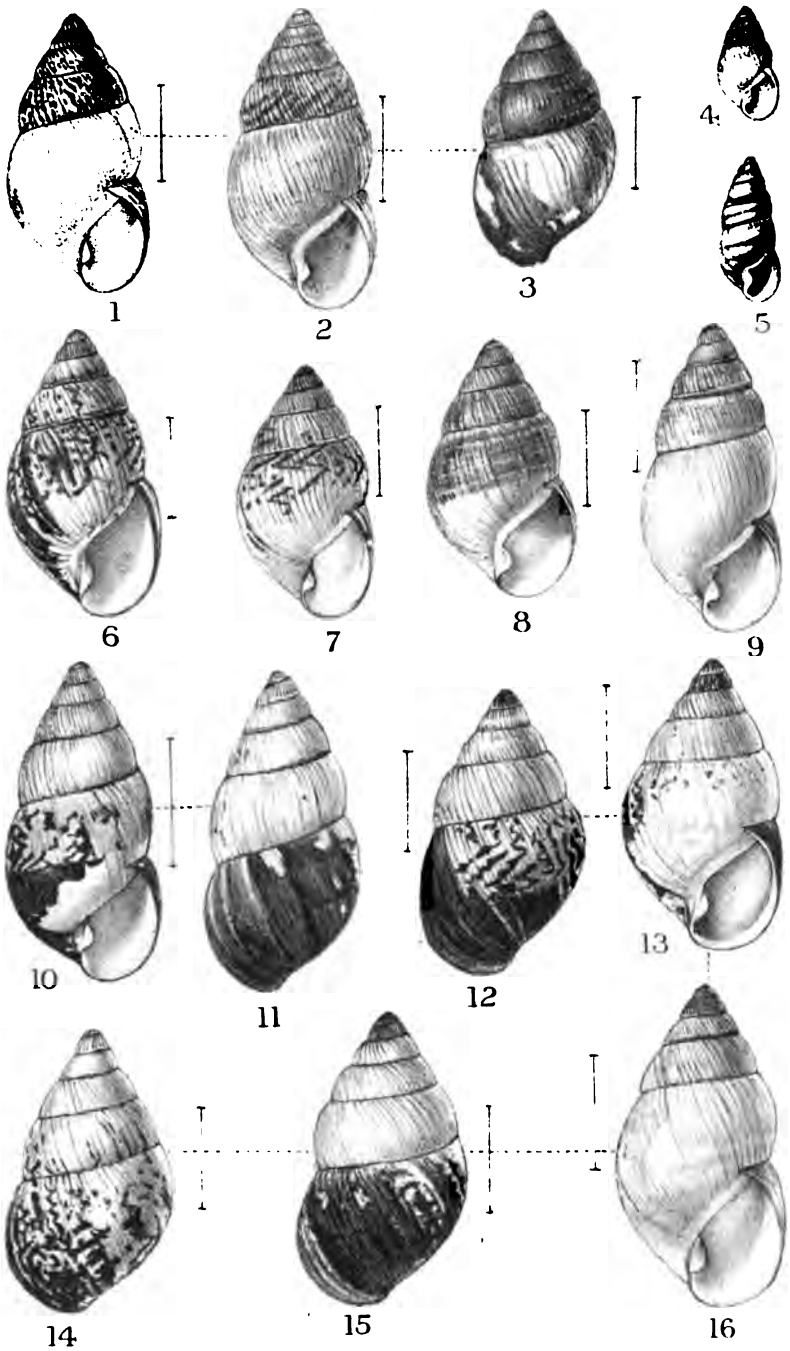

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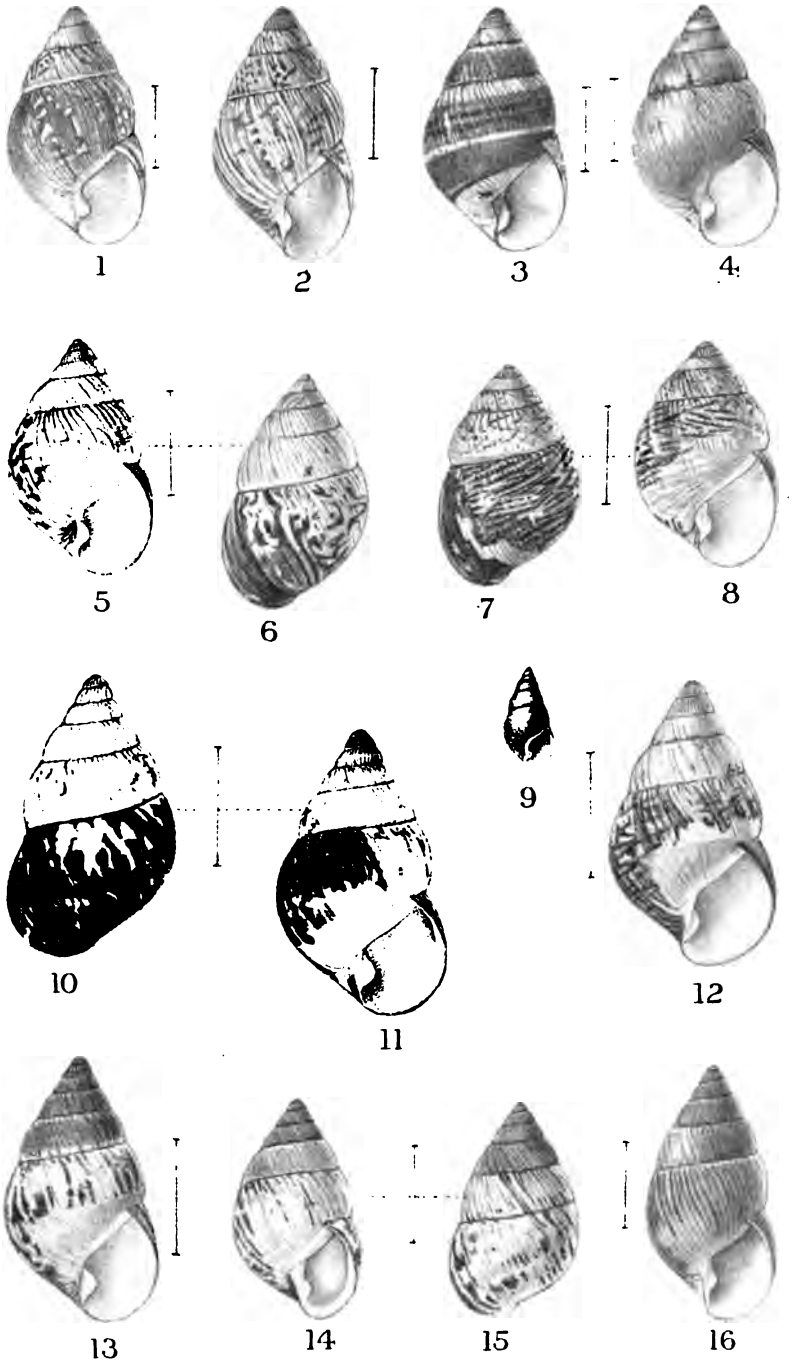

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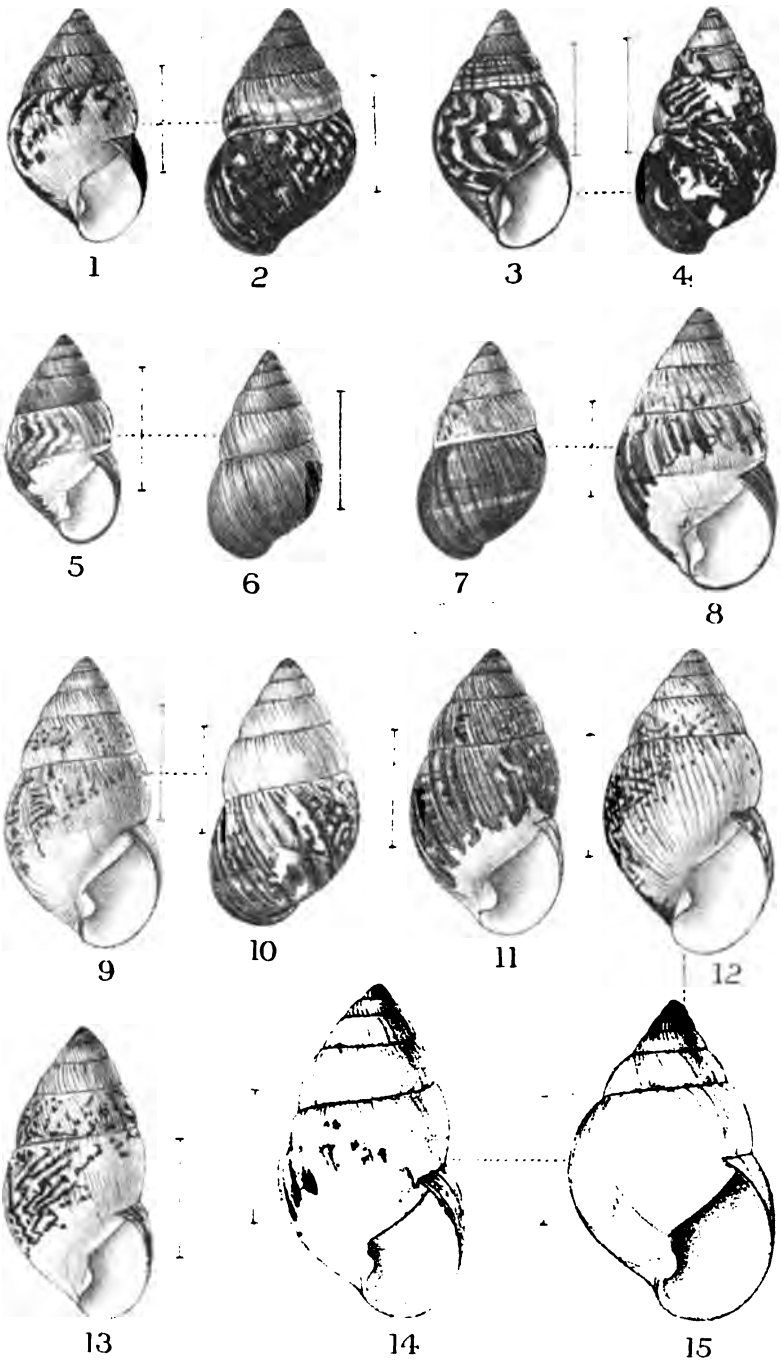

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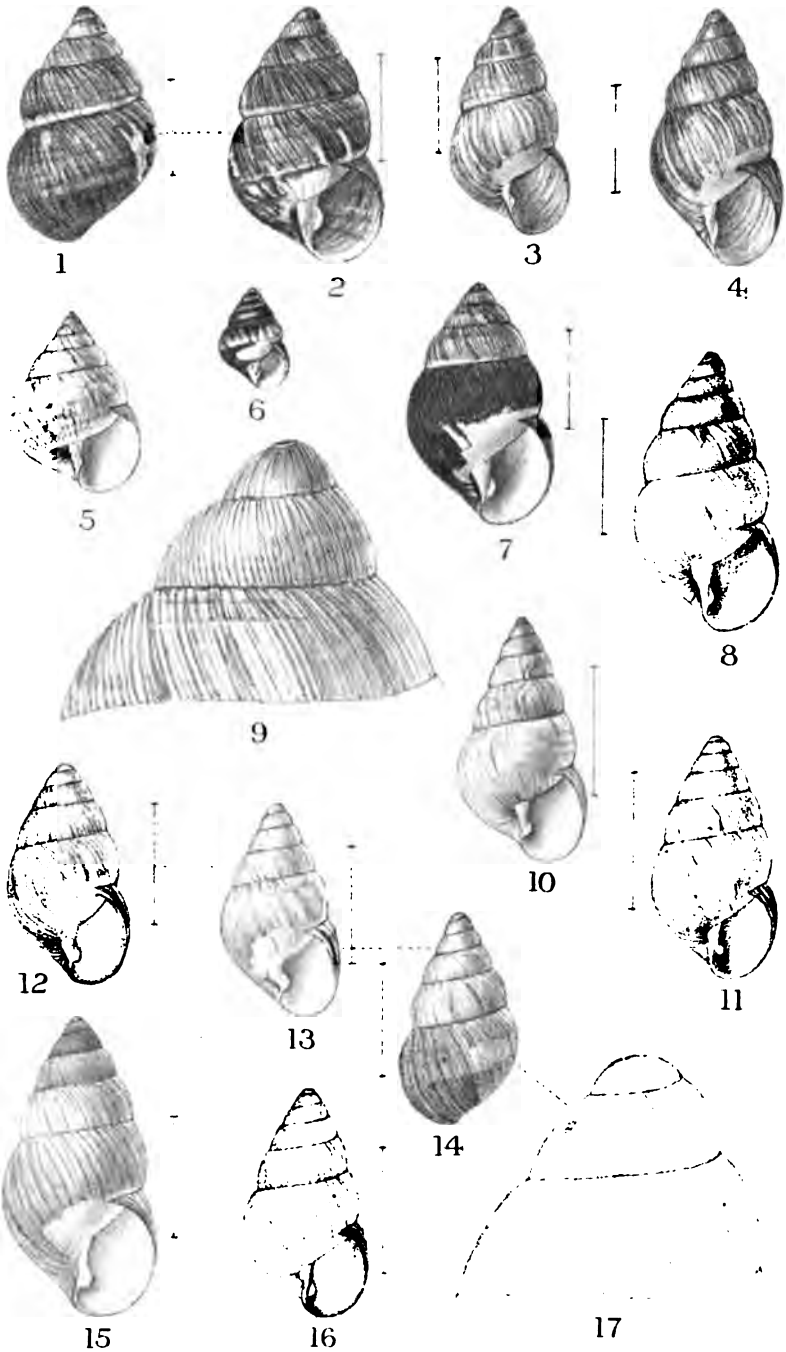

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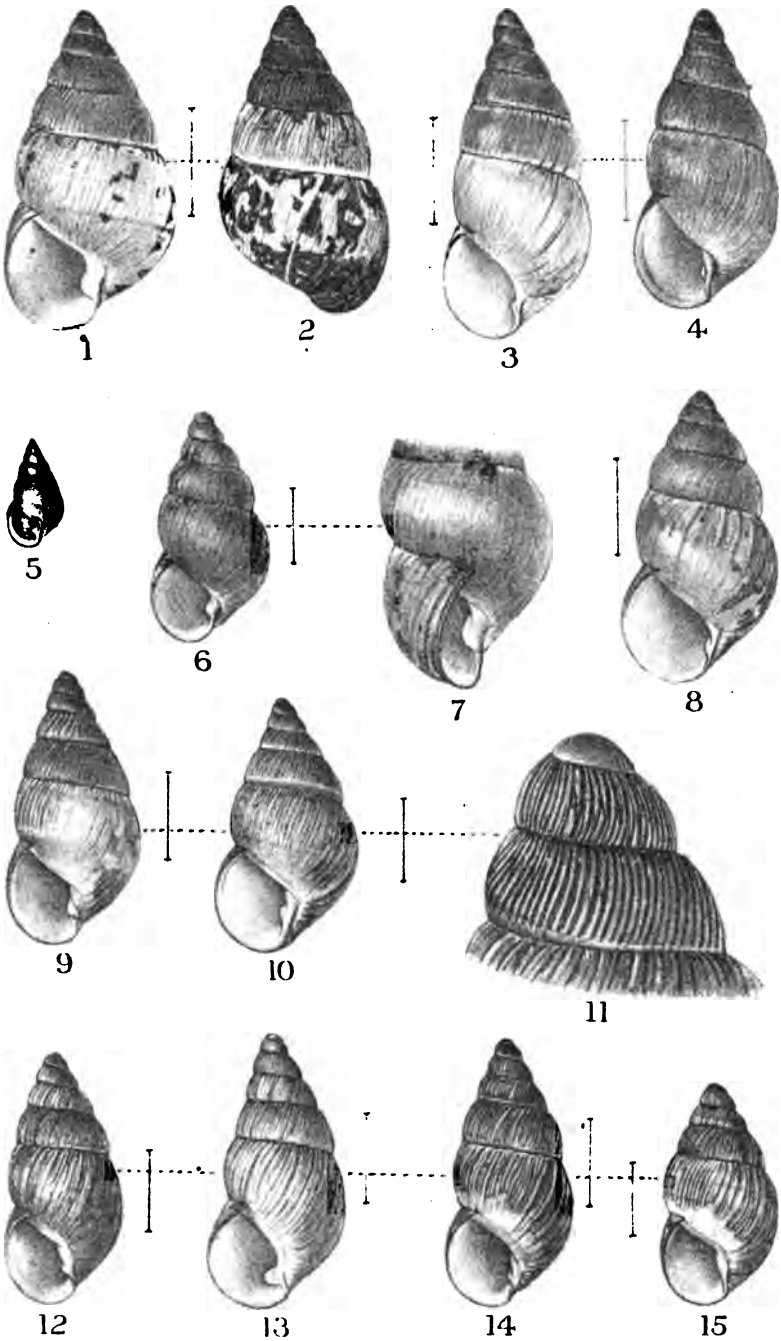

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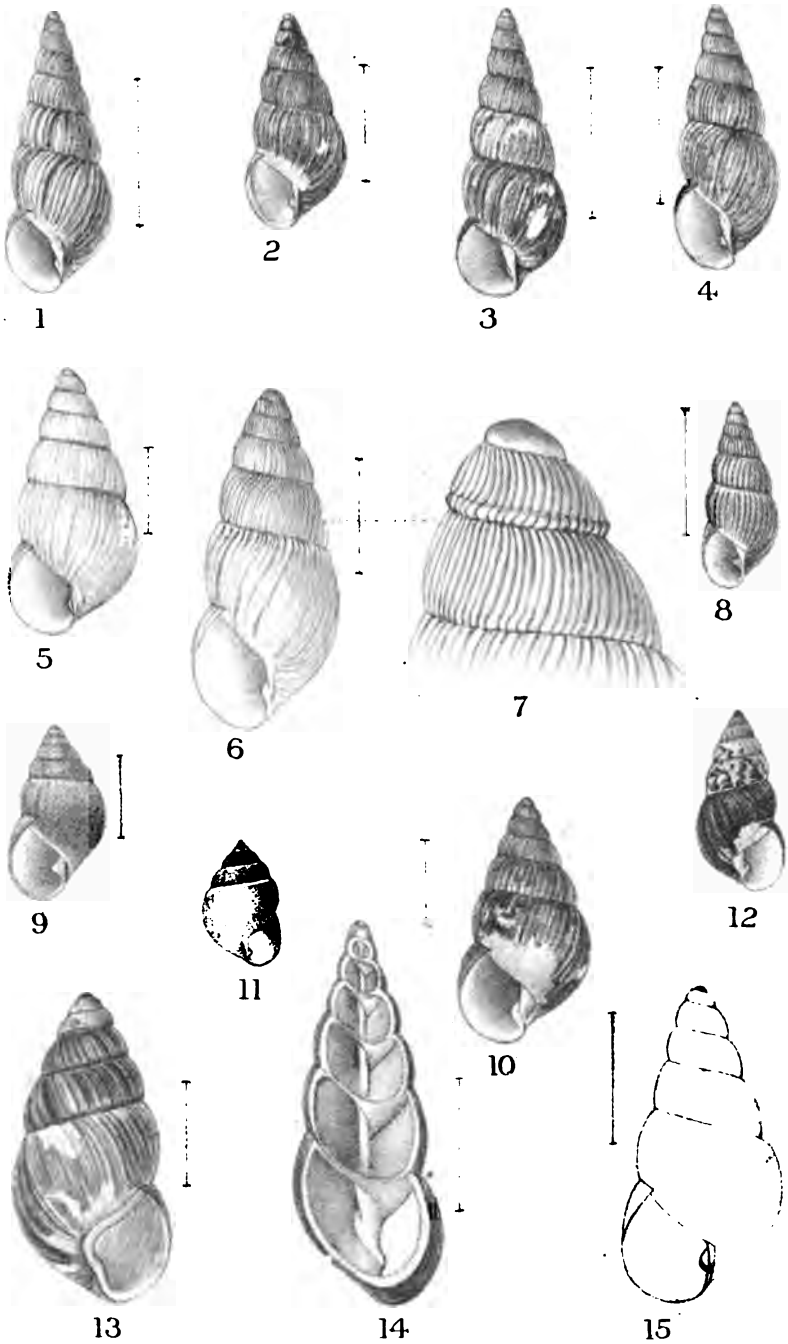

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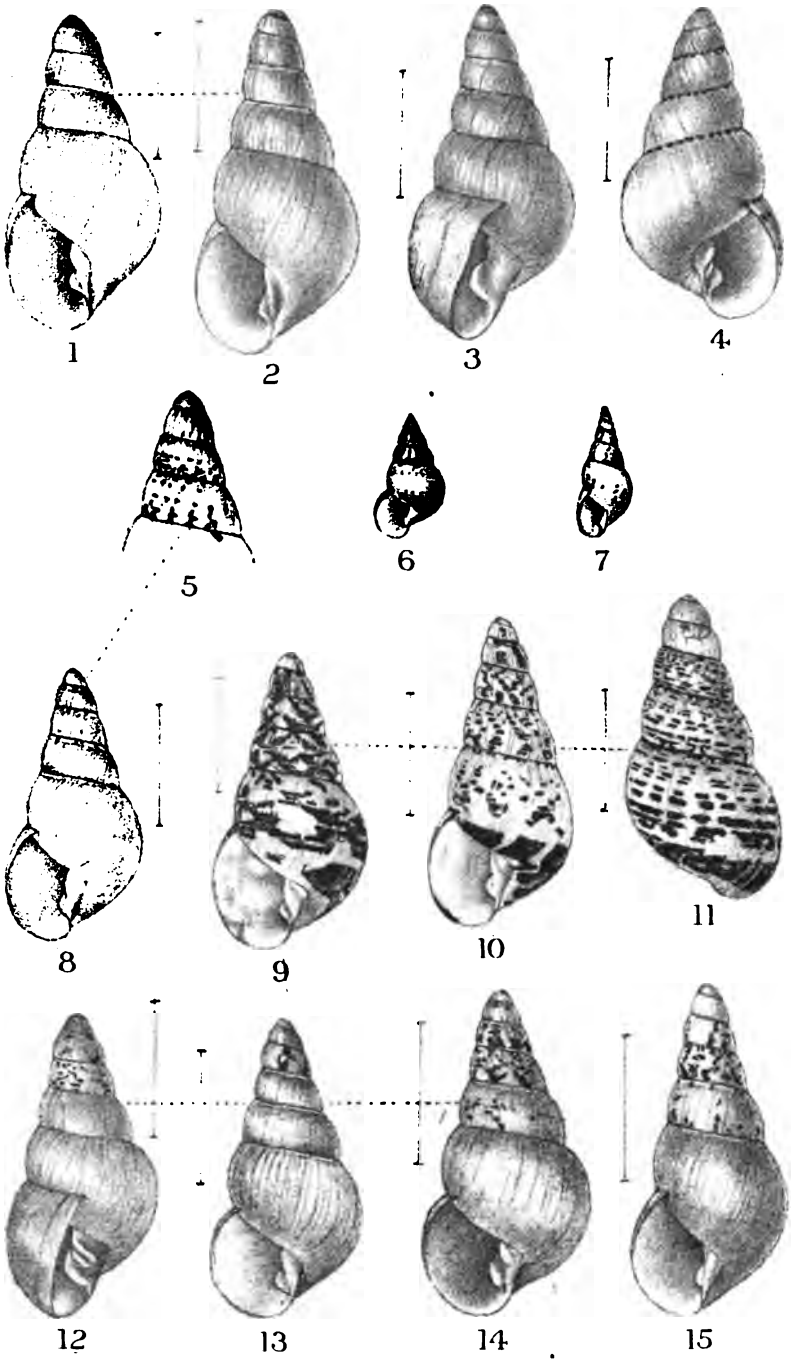

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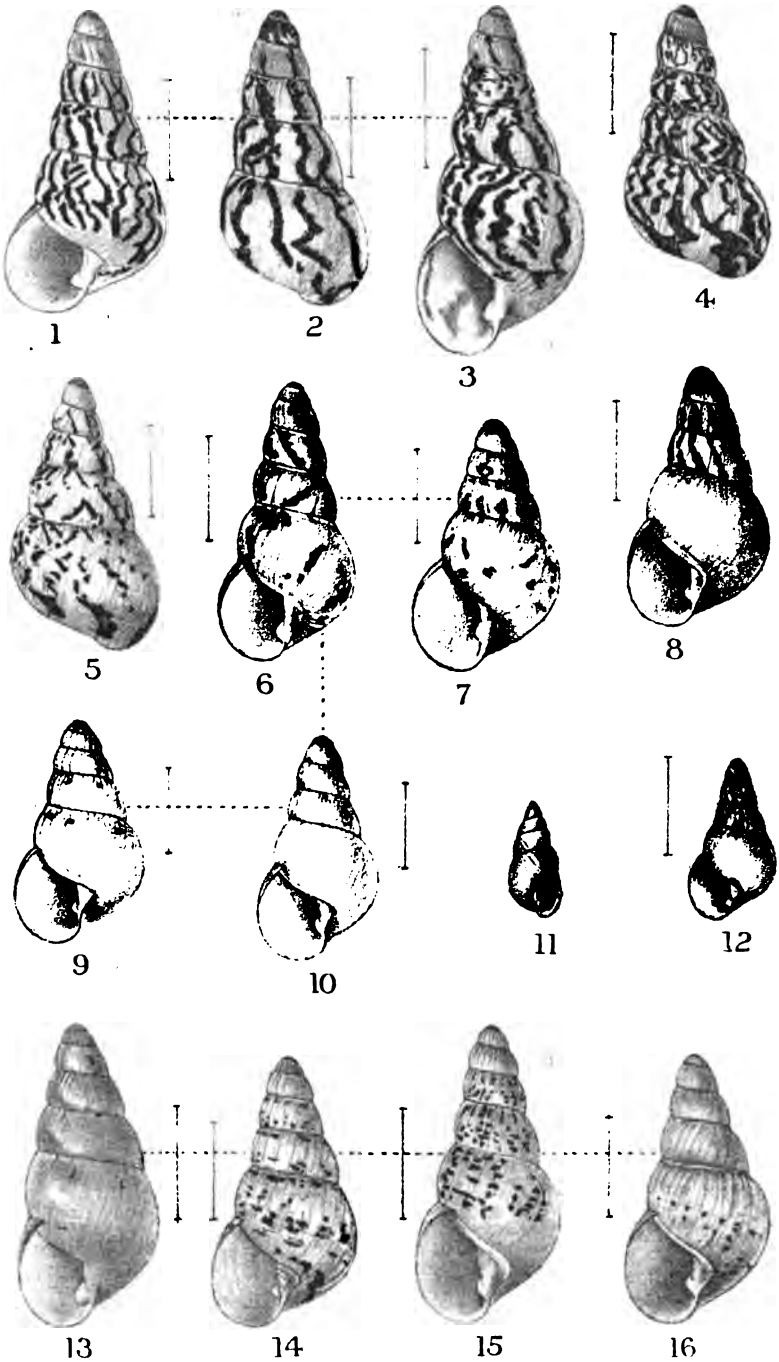

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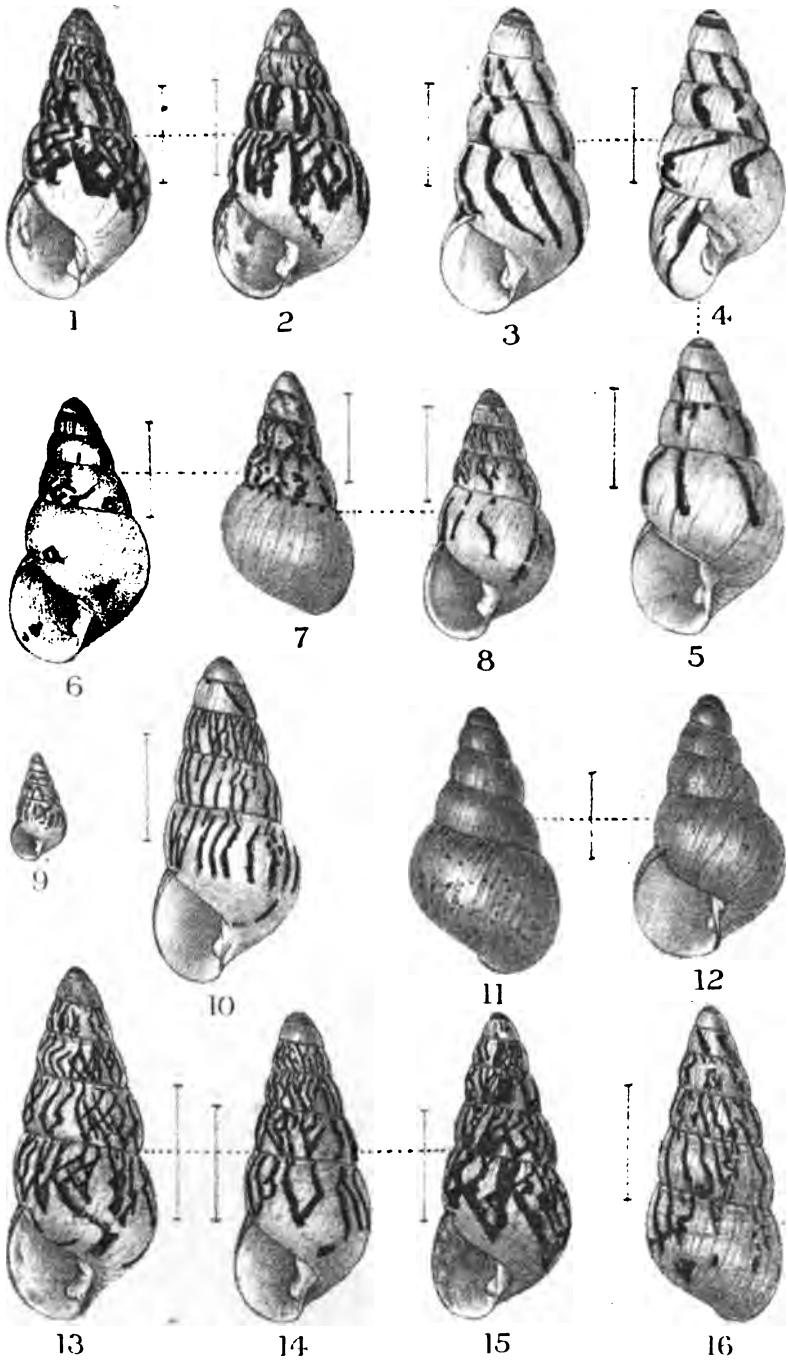

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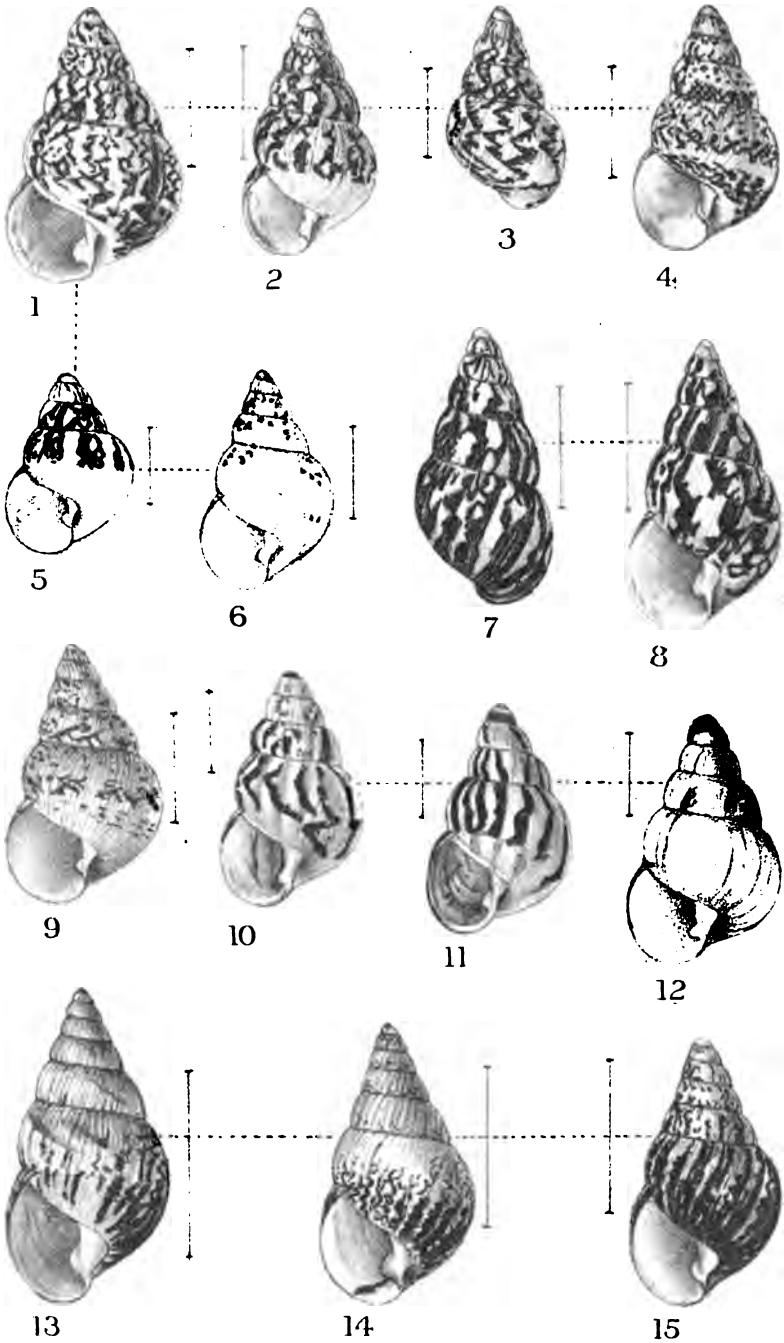

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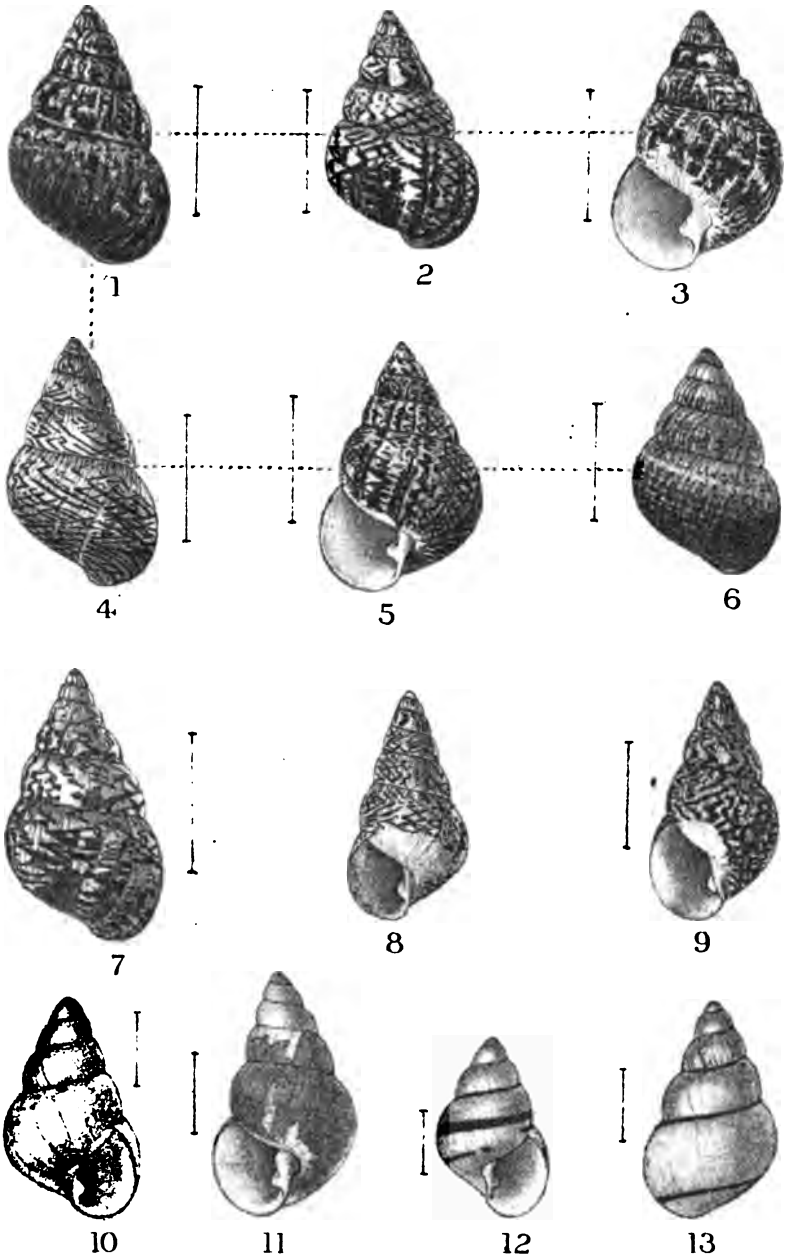

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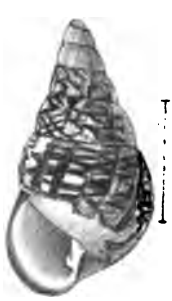
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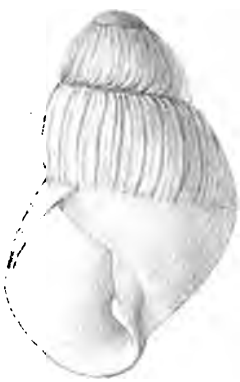

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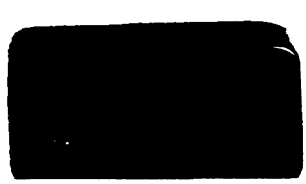

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